

**INSTALLATION RESTORATION PROGRAM**

**CLOSURE REPORT  
DISCHARGE AREA 4**

**CASTLE AIR FORCE BASE  
CALIFORNIA**

**NOVEMBER 2005**

**FINAL**

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## EXECUTIVE SUMMARY

This closure report describes the implementation of the selected remedy at Discharge Area 4 (DA-4), Castle Airport, California. The *Source Control Operable Unit (SCOU) Record of Decision (ROD) Part 2* established soil vapor extraction (SVE) with supplemental excavation as the selected remedy for DA-4. Implementation of the selected remedy was required in order to reduce concentrations of trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE) in accordance with Castle Air Force Base remedial action objectives (RAOs).

SVE was initially implemented at DA-4 as a removal action beginning in August 1996. Approximately 340 pounds of VOCs were removed through March 2003. However, TCE concentrations rebounded substantially upon termination of SVE, most notably in the source area near a subsurface concrete vault. The concrete vault significantly impeded vapor flow in the source area, preventing SVE from effectively removing the primary VOC source. Therefore, the vault and associated contaminated soil were excavated in October 2004. Approximately 145 cubic yards of soil, concrete, and debris were excavated and disposed at an offsite facility. Confirmation sampling results indicated that the primary source of VOCs was removed during the excavation. All excavated soil was classified as non-hazardous based on soil sample analysis and profiling. The excavation was backfilled with certified clean fill.

SVE was performed upon completion of excavation and backfilling to remove residual VOCs. SVE was performed primarily from source area vapor wells in three phases: October 26, 2004 through December 10, 2004; December 28, 2004 through January 18, 2005; and March 9, 2005 through April 6, 2005. TCE concentration rebound was evaluated between each episode, and final vapor sampling was conducted on June 8, 2005. An additional 4.7 pounds of VOCs were removed by SVE after excavation, and final vapor sampling results confirmed that VOC concentrations have been substantially reduced as a result of the remedy.

The *SCOU Human Health Risk Assessment (HHRA)* concluded that DA-4 does not pose an adverse risk to human health, and indoor air modeling results using the J&E model suggest that residual VOC concentrations at DA-4 do not represent an adverse threat to human health via the indoor inhalation exposure pathway. The STOP evaluation indicates that the selected remedy has reduced concentrations of TCE and cis-1,2-DCE to levels that are protective of groundwater quality. Therefore, RAOs as specified in the *SCOU ROD Part 2* have been attained, and accordingly, no contaminants are present at DA-4 that present an adverse risk to human health or groundwater quality. DA-4 is therefore recommended for closure and no further action.

## LIST OF ACRONYMS AND ABBREVIATIONS

mg/kg	milligrams per kilogram
µg/L	micrograms per liter
AFCEE	Air Force Center for Environmental Excellence
AST	aboveground storage tank
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
CAF B	Castle Air Force Base
COC	contaminant of concern
DA-4	discharge area 4
cis-1,2-DCE	cis-1,2-dichloroethene
DTSC	California Department of Toxic Substances Control
GC	gas chromatograph
HHRA	human health risk assessment
IRP	Installation Restoration Program
LOX	liquid oxygen
MIS	Management Information System
ML	silt
MCL	maximum contaminant level
NFA	no further action
PVC	polyvinyl chloride
RAO	remedial action objective
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SAC	Strategic Air Command
SCOU	Source Control Operable Unit
scfm	standard cubic feet per minute
STOP	SVE Termination or Optimization Process
SVE	soil vapor extraction
TCE	trichloroethene
USAF	United States Air Force
UST	underground storage tank
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
WQSA	water quality site assessment

## **1.0 INTRODUCTION**

### **1.1 PROJECT DESCRIPTION**

The *Source Control Operable Unit (SCOU) Record of Decision (ROD) Part 2* (Earth Tech, 2003a) established soil vapor extraction (SVE) with supplemental excavation as the selected remedy for DA-4. Implementation of the selected remedy specifically included a period of SVE, implemented as a removal action, followed by the excavation and disposal of contaminated soil; excavation, demolition, and disposal of the concrete vault; confirmation soil sampling; backfilling with clean soil; installation and startup of a SVE system; operation, maintenance, and associated sampling of the SVE system; and confirmation sampling at the end of a 60-day rebound period. The selected remedy was implemented to reduce concentrations of TCE and cis-1,2-DCE in soil and soil gas to levels compliant with Castle AFB RAOs specified in the *SCOU ROD Part 2*.

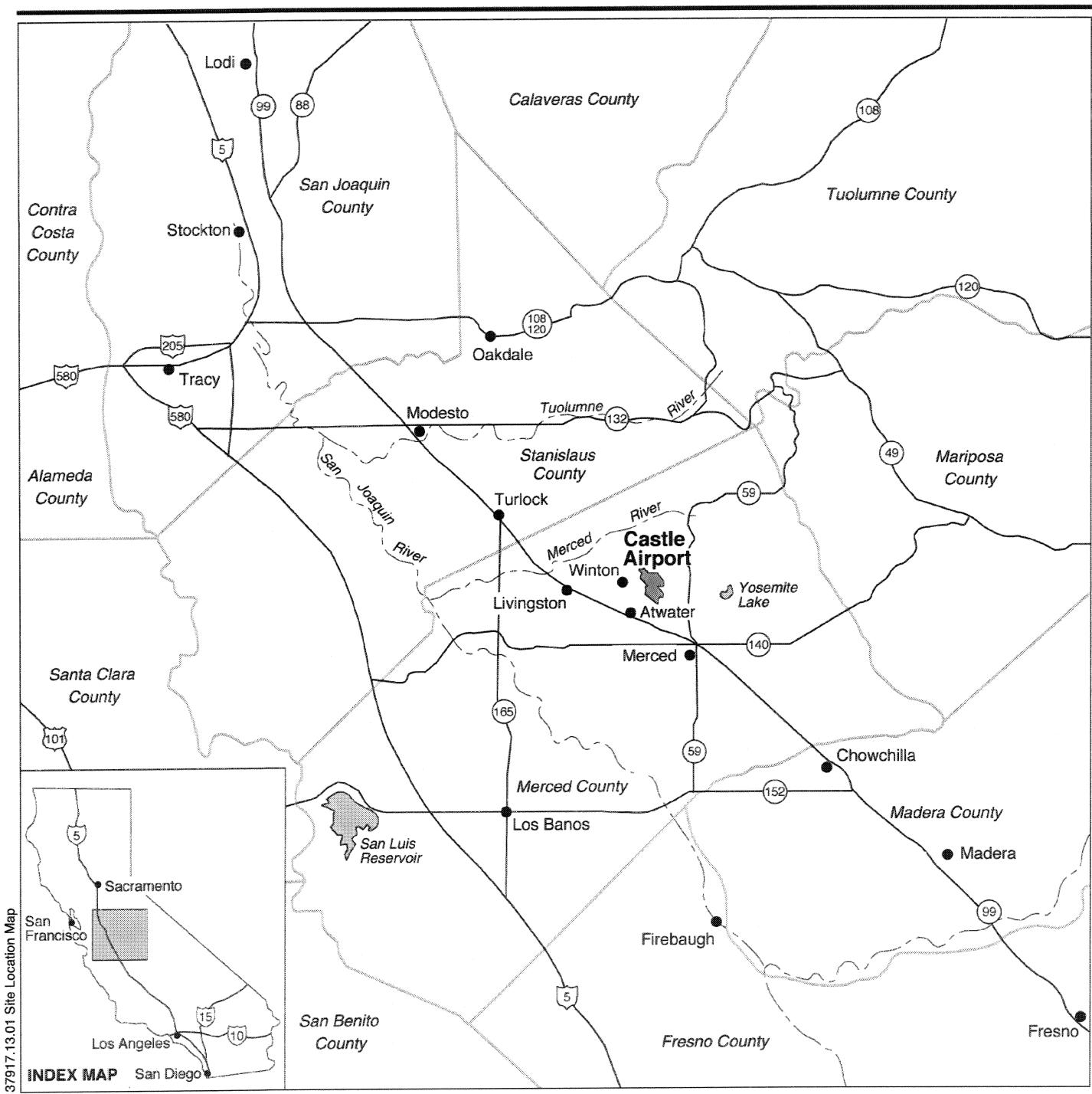
SVE was initially implemented at DA-4 as a removal action beginning in August 1996. Approximately 340 pounds of VOCs were removed through March 2003. However, TCE concentrations rebounded substantially upon termination of SVE, most notably in the source area near a subsurface concrete vault. The concrete vault significantly impeded vapor flow in the source area, preventing SVE from effectively removing the primary VOC source. Therefore, the vault and associated contaminated soil were excavated, and SVE was again performed to remove residual VOCs. The remedial action was performed as described in the *Remedial Action Work Plan* (Earth Tech, 2004).

### **1.2 CASTLE AIRPORT HISTORY AND BACKGROUND**

#### **1.2.1 CASTLE AIRPORT BACKGROUND**

Castle Airport, formerly known as Castle Air Force Base (CAFAB), is located in Merced County near the central California San Joaquin Valley towns of Winton to the west, Atwater to the southwest, and Merced to the southeast (Figure 1-1). Castle Airport covers 2,777 acres comprising runway and airfield operations, industrial areas, housing, recreational facilities, and several noncontiguous parcels of land located in the immediate vicinity of Castle Airport.

Construction to establish an Army Flying School in Merced began on the property currently known as Castle Airport on 30 June 1941. The Merced Army Flying School was officially established on 20 September 1941.



#### EXPLANATION

- Interstate Highway
- U. S. Highway
- State Highway
- County Line

#### Location of Castle Airport

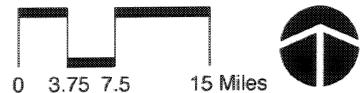


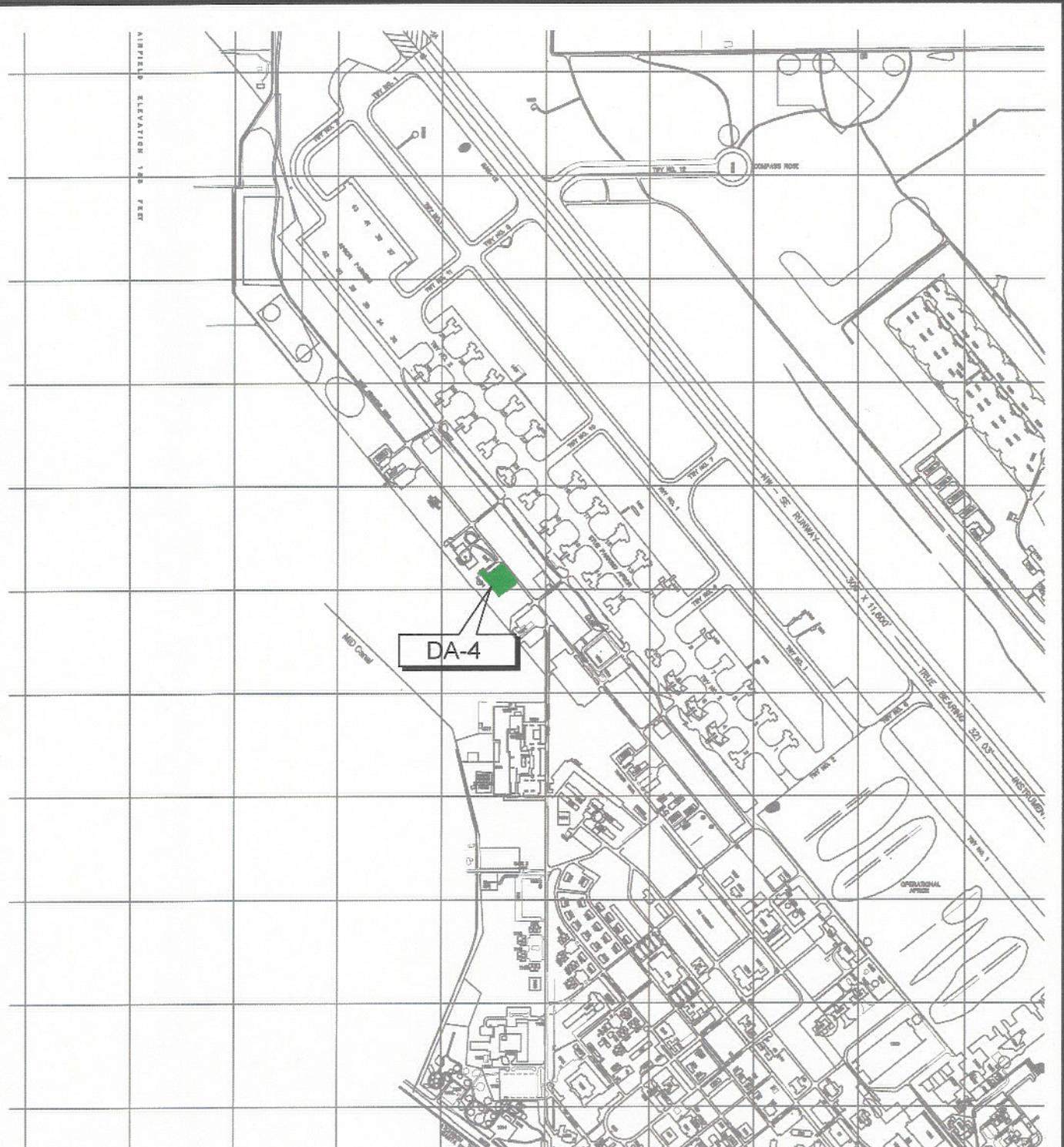
Figure 1-1

On 8 May 1943, the Merced Army Flying School became part of the Western Flying Training Command and was designated as the Merced Army Air Field. The Strategic Air Command (SAC) took control of the field in 1946, renaming the Air Field as Castle Army Air Field in honor of the late Brigadier General Frederick W. Castle. The field was designated as CAFB in 1948.

CAFB was decommissioned on 30 September 1995 under the authority of the Defense Authorization Amendments and Base Realignment and Closure (BRAC) Act of 1988 and the Defense Base Closure and Realignment Act (DBCRA) of 1990. CAFB was subject to the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) upon authorization of SARA in 1986. CAFB was proposed for the National Priorities List (NPL) of hazardous waste sites on 22 July 1987. The former base was officially listed as an NPL site on 21 November 1989, and has been assigned EPA identification number CA3570024551. Remedial activities at CAFB are funded through the Department of Defense as a component of Base Realignment and Closure (BRAC) Environmental Cleanup. The EPA, California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) and the Air Force signed an inter-agency agreement, known as the Castle Air Force Base Federal Facility Agreement (FFA) on 21 July 1989. The FFA is a legal/contractual document governing the BRAC Closure Team (BCT) relationships and cleanup processes. The Air Force, U.S. EPA, DTSC, and the RWQCB Central Valley Region comprise the BRAC Cleanup Team (BCT), with the Air Force serving as lead agency. Decisions regarding site assessment and cleanup at Castle Airport are agreed upon by the BCT.

### **1.3 DA-4 BACKGROUND**

DA-4 included a liquid oxygen (LOX) manufacturing and storage facility, which operated from the early 1950s until the mid 1960s. A site location map is provided on Figure 1-2. Solvents (including TCE) were used to clean the filters at this facility. There were four aboveground storage tanks (ASTs) associated with the LOX facility: two 5,000-gallon LOX tanks and two nitrogen tanks (2,000- and 4,000-gallon). According to CAFB records, the solvents were discharged to surface or subsurface soils through a shallow trench and concrete vault. The vault has been previously referred to as a dry well or French drain. The site formerly included Building 1314 (B1314), which was used as a tool shed and has been demolished. A former underground storage tank (UST) was located northeast of B1314 and an idle underground fuel line runs east of the former building. The Air Force Management Information System (MIS) number for DA-4 is SD012.



NORTH  
0 700 1400  
SCALE IN FEET

DA-4 Site Location		
Castle Airport		
Date: 08-04	EARTH TEC A CH2M INTERNATIONAL COMPANY	Figure
Project No. 79887		1-2

During the Phase 1 RI, soil and soil gas samples were collected from suspected release areas, including the vault, drainage trench and underground fuel line. During the Phase 2 RI, step-out soil borings were drilled near the former UST location and vault, and soil and soil gas samples were collected to determine the extent of contamination surrounding these suspected sources. A summary of the number and types of samples, analyses, and maximum detections during the SCOU RI is presented below.

DA-4 SCOU RI Sampling Summary			
Soil Borings	Soil Gas Probes	Soil Samples	Soil Gas Samples
22	9	73	58

DA-4 SCOU RI Analysis Summary	
Contaminant Category	Analytical Method
<b>Soil Analyses</b>	
VOCs	SW8260
SVOCs	SW8270
Petroleum Hydrocarbons	CA8015/TVPH & TEPH
Metals	SW6010
<b>Soil Gas Analyses</b>	
VOCs	SGVOC, E18
	TO-14

DA-4 SCOU RI Maximum Detections				
Contaminant Category	Contaminant of Potential Concern	Maximum Concentration	Depth (feet bgs)	Units
<b>Soil Results</b>				
VOCs	TCE	240	19.5-20	mg/kg
<b>Soil Gas Results</b>				
VOCs	TCE	9,115	30	µg/L
	cis-1,2-DCE	440	5	µg/L

Chlorinated VOCs were detected in soil and soil gas samples to respective depths of approximately 40 and 60 feet bgs. A complete presentation of RI activities/results for DA-4 is provided in Section 7.6.1 of the SCOU RI/FS (JEG, 1997a). After the Phase 2 RI, the BCT agreed that the DA-4 site was sufficiently characterized to

support selection of an appropriate remedy. However, the BCT decided that additional sampling and analysis would be required during the remedial action to refine estimates of the extent of TCE contamination at DA-4.

No contamination above risk-screening levels was identified at DA-4 during the SCOU RI. Thus, the *SCOU HHRA* (JEG, 1997b) concluded that DA-4 does not pose an adverse risk to human health. However, the detected levels of TCE and cis-1,2-DCE in soil and soil gas did exceed the groundwater protective levels established in the SCOU RI. Accordingly, soil contamination measured during the SCOU RI/FS was determined to pose a threat to groundwater quality as a continuing contaminant source. SVE with supplemental excavation is documented as the selected remedy for DA-4 in the *SCOU ROD Part 2* (Earth Tech, 2003).

#### **1.4 REMEDIAL ACTION OBJECTIVES**

Castle Airport RAOs are based on the protection of human health and groundwater quality. RAOs were separately established for the protection of human health, based on the SCOU HHRA, and for the protection of groundwater quality, based on the SCOU WQSA. Both the human health- and groundwater quality-protective RAOs are applicable to any sites where the HHRA RAOs or the WQSA thresholds are exceeded. In all cases, the human health RAOs must be attained and, if they are lower, the groundwater protective RAOs must also be attained.

The SCOU HHRA established that there are no COCs at DA-4 that pose an adverse risk to human health. However, the SCOU RI/FS identified TCE and cis-1,2-DCE in soil and soil gas at DA-4 in excess of VLEACH2 WQSA thresholds. The groundwater-protective RAO for VOCs that exceed the VLEACH2 WQSA threshold is the lowest level technically and economically achievable to protect human health and the environment, including groundwater quality, as determined by the STOP evaluation discussed further below. The WQSA thresholds were established in the SCOU RI/FS and are intended to represent contaminant concentrations in the soil and soil gas that do not pose an adverse impact to groundwater quality. WQSA thresholds for VOCs are provided on Table 1-1. Based on the SCOU HHRA and the environmental assessment, site contaminants of concern (COCs) and RAOs for DA-4 as identified in the SCOU ROD Part 2 are listed below.

COC (concentration)	RAO Source	RAO
TCE (240 mg/kg, soil)	STOP	VLEACH2 - .018 mg/kg, 10 to 20 feet bgs or lowest level technically and economically achievable
TCE (1,000 µg/L, soil gas)	STOP	VLEACH2 - 19 µg/L, 10 to 20 feet bgs or lowest level technically and economically achievable
TCE (9,115 µg/L, soil gas)	STOP	VLEACH2 – 10.6 µg/L, 20 to 30 feet bgs or lowest level technically and economically achievable
cis-1,2-DCE (0.100 mg/kg, soil)	STOP	VLEACH2 - 0.008 mg/kg, 10 to 20 feet bgs or lowest level technically and economically achievable
cis-1,2-DCE (440 µg/L, soil gas)	STOP	VLEACH2 – 40.7 µg/L, 0 to 10 feet bgs or lowest level technically and economically achievable

TCE and cis-1,2-DCE in soil and soil gas represent adverse risk to groundwater quality. No COCs representing adverse risk to human health are present at DA-4.

For sites with soil or soil gas contamination that exceed VLEACH2 thresholds, SVE must be implemented until either the VLEACH2 thresholds are attained or application of the STOP process establishes that the lowest levels technically and economically achievable have been attained. The STOP evaluation integrates scientific, economic, and engineering judgment to answer the following decision criteria:

- I. Will the contaminant mass in the vadose zone reach the groundwater?
- II. Will the contaminant mass in the vadose zone cause the contaminant concentrations in the leachate to exceed the aquifer cleanup level?
- III. Is it appropriate to terminate an SVE system at this site?

If the answer to criterion I or II is no, then SVE can be terminated and site closure proceedings can be initiated. Detailed STOP criteria are provided in the *SCOUR ROD Part 2* (Earth Tech, 2000b).

STOP decision criteria I and II are addressed in Section 5, VLEACH screening, and STOP decision criterion III is addressed in Section 6, Groundwater Modeling, and Section 7, Conclusions.

VLEACH2 values were not established as the groundwater protective RAOs due to the technical and economic uncertainty of attaining them. Attainment of the groundwater protective RAO for VOCs is determined by the

STOP evaluation. The STOP evaluation is initiated at a site where SVE is part of the remedy when, among other criteria, VOC concentrations at the site do not, or no longer, exceed the human health RAOs for VOCs, (i.e., the site does not pose an unacceptable risk to human health from VOC contaminants).

**Table 1-1**  
**HHRA RAOs and WQSA Thresholds for VOCs in Soil and Soil Gas**

Contaminant	Model	WQSA Threshold for Given Maximum Depths of Contamination ( $\mu\text{g}/\text{kg}$ [soil], $\mu\text{g}/\text{L}$ [soil gas])						HHRA RAOs (Residential Scenario)	
		Shallow			Deep				
		0-10'	10-20'	20-30'	30-40'	40-50'	50-60'		
<b>Volatile Organics<sup>1</sup></b>									
benzene (soil)	VLEACH1	88,567.0	19,594.0	5,658.0	1,698.9	501.1	86.2	360	
	VLEACH2	291.5	68.4	20.8	3.0	1.4	0.0		
benzene (soil gas)	VLEACH1	85,763.0	18,974.0	5,479.0	1,645.2	485.2	83.5		
	VLEACH2	282.2	66.3	20.1	5.9	1.4	0.1		
carbon tetrachloride (soil)	VLEACH1	2,700.0	1,000.0	500.0	300.0	200.0	100.0	240	
	VLEACH2	47.8	18.3	10.2	6.6	4.6	1.7		
carbon tetrachloride (soil gas)	VLEACH1	2,846.8	1,040.1	559.1	352.7	235.0	102.4		
	VLEACH2	49.6	19.0	10.6	6.9	4.8	1.8		
chloroform (soil)	VLEACH1	8,900.0	2,000.0	5,700.0	1,700.0	500.0	100.0	450	
	VLEACH2	291.5	68.4	20.8	3.0	1.4	0.0		
chloroform (soil gas)	VLEACH1	85,763.0	18,974.0	5,479.0	1,645.2	485.2	83.5		
	VLEACH2	282.2	66.3	20.1	5.9	1.4	0.1		
dichlorobenzene, 1,2-(soil)	VLEACH1	293,400.0	102,200.0	28,500.0	8,600.0	2,500.0	500.0	370,000	
	VLEACH2	293,350.0	195,050.0	54,641.0	15,397.0	2,847.5	25.2		
dichlorobenzene, 1,2-(soil gas)	VLEACH1	56,439.0	19,962.0	5,479.3	1,646.1	490.2	93.5		
	VLEACH2	56,439.0	37,525.0	10,512.0	2,962.3	547.8	4.8		
dichlorobenzene, 1,4-(soil)	VLEACH1	293,400.0	102,200.0	28,500.0	8,600.0	2,500.0	500.0	3,600	
	VLEACH2	293,350.0	195,050.0	54,641.0	15,397.0	2,847.5	25.2		
dichlorobenzene, 1,4-(soil gas)	VLEACH1	56,439.0	19,962.0	5,479.3	1,646.1	490.2	93.5		
	VLEACH2	56,439.0	37,525.0	10,512.0	2,962.3	547.8	4.8		
dichlородифluoromethane (FC12)- (soil)	VLEACH1	85.0	25.0	12.0	6.0	3.0	1.0	280,000	
	VLEACH2	8.5	2.5	1.2	0.6	0.3	0.1		
dichlородифluoromethane (FC12)- (soil gas)	VLEACH1	21,035.0	6,187.5	2,850.5	1,548.9	845.8	312.7		
	VLEACH2	2,001.3	620.6	286.5	156.8	85.4	14.2		

**Table 1-1**  
**HHRA RAOs and WQSA Thresholds for VOCs in Soil and Soil Gas**

Contaminant	Model	WQSA Threshold for Given Maximum Depths of Contamination (µg/kg [soil], µg/L [soil gas])					HHRA RAOs (Residential Scenario)	
		Shallow		Deep				
		0-10'	10-20'	20-30'	30-40'	40-50'	50-60'	
dichloroethane, 1,2- (soil)	VLEACH1	84.9	25.0	11.5	6.3	3.4	1.3	
dichloroethane, 1,2- (soil gas)	VLEACH2	8.5	2.5	1.2	0.6	0.3	0.1	
dichloroethylene, cis-, 1,2- (soil)	VLEACH1	21,035.0	6,187.5	2,850.5	1,548.9	845.8	312.7	
dichloroethylene, cis-, 1,2- (soil)	VLEACH2	2,001.3	620.6	286.5	156.8	85.4	34.2	
dichloroethylene, cis-, 1,2- (soil gas)	VLEACH1	1,212.7	454.7	249.5	160.7	110.0	50.8	140,000
dichloropropane, 1,2- (soil)	VLEACH2	21.5	8.4	4.8	3.2	2.3	1.0	
dichloropropane, 1,2- (soil)	VLEACH1	2,294.0	860.1	472.0	304.0	208.1	96.0	
dichloropropane, 1,2- (soil)	VLEACH2	40.7	16.0	9.1	6.1	4.4	1.8	
dichloropropane, 1,2- (soil gas)	VLEACH1	—	—	—	—	—	—	670
dichloropropane, 1,2- (soil)	VLEACH2	—	—	—	—	—	—	
ethylbenzene (soil)	VLEACH1	220,400.0	88,804.0	24,747.0	7,435.9	2,226.0	442.4	230,000
ethylbenzene (soil)	VLEACH2	220,340.0	220,340.0	78,540.0	22,619.0	4,383.4	42.1	
ethylbenzene (soil gas)	VLEACH1	48,799.0	19,662.0	5,479.3	1,646.3	492.1	97.9	
methylene chloride (soil)	VLEACH2	48,785.0	48,785.0	17,391.0	5,008.2	970.6	9.3	
methylene chloride (soil)	VLEACH1	84.9	25.0	11.5	6.3	3.4	1.3	2,300
methylene chloride (soil gas)	VLEACH2	8.5	2.5	1.2	0.6	0.3	0.1	
naphthalene (soil)	VLEACH1	21,035.0	6,187.5	2,850.5	1,548.9	845.8	312.7	
naphthalene (soil)	VLEACH2	2,001.3	620.6	286.5	156.8	85.4	34.2	
naphthalene (soil gas)	VLEACH1	82,907.0	82,907.0	82,907.0	21,969.0	1,707.6	190,000	
naphthalene (soil gas)	VLEACH2	82,896.0	82,896.0	82,896.0	68,348.0	74.9		
tetrachloroethylene (soil)	VLEACH1	2,700.0	1,000.0	500.0	300.0	200.0	100.0	3,800
tetrachloroethylene (soil)	VLEACH2	47.8	18.3	10.2	6.6	4.6	1.7	

**Table 1-1**  
**HHRA RAOs and WQSA Thresholds for VOCs in Soil and Soil Gas**

Contaminant	Model	WQSA Threshold for Given Maximum Depths of Contamination (μg/kg [soil], μg/L [soil gas])						HHRA RAOs (Residential Scenario) < 15 feet (μg/kg)	
		Shallow			Deep				
		0-10'	10-20'	20-30'	30-40'	40-50'	50-60'		
tetrachloroethene (soil gas)	VLEACH1	2,846.8	1,040.7	559.1	352.7	235.0	102.4	1.8	
	VLEACH2	49.6	19.0	10.6	6.9	4.8	1.8		
toluene (soil)	VLEACH1	215,810.0	44,728.0	12,463.0	3,744.0	1,128.0	207.6	520,000	
	VLEACH2	315,150.0	75,409.0	21,600.0	6,148.9	1,201.8	25.7		
toluene (soil gas)	VLEACH1	94,872.0	19,662.0	5,479.0	1,645.9	489.2	91.3	N/A	
	VLEACH2	138,540.0	33,150.0	9,495.3	2,703.0	528.3	11.3		
TVPH-volatile (as gasoline in soil)	DLM	100,000.0	100,000.0	30,000.0	10,000.0	5,000.0	1,000.0	N/A	
	DLM	-----	-----	-----	-----	-----	-----		
TEPH-extractable (as diesel JP-4 in soil)	DLM	1,500,000.0	1,500,000.0	500,000.0	500,000.0	100,000.0	10,000.0	N/A	
	DLM	-----	-----	-----	-----	-----	-----		
trichloroethylene (soil)	VLEACH1	2,742.8	1,002.1	538.7	339.8	226.5	98.7	3,700	
	VLEACH2	47.8	18.3	10.2	6.6	4.6	1.7		
trichloroethylene (soil) gas	VLEACH1	2,846.8	1,040.1	559.1	352.7	235.0	102.4	N/A	
	VLEACH2	49.6	19.0	10.6	6.9	4.8	1.8		
trichlorofluoromethane (FC11)- (soil)	VLEACH1	85.0	25.0	12.0	6.0	3.0	1.0	1,200,000	
	VLEACH2	8.5	2.5	1.2	0.6	0.3	0.1		
trichlorofluoromethane (FC11)- (soil gas)	VLEACH1	21,035.0	6,187.5	2,850.5	1,548.9	845.8	312.7	N/A	
	VLEACH2	2,001.3	620.6	286.5	156.8	85.4	14.2		
trimethylbenzene, 1,2,4- (soil)	VLEACH1	293,350.0	102,200.0	28,480.0	8,555.9	2,547.9	485.9	120,000	
	VLEACH2	293,350.0	195,050.0	54,641.0	15,397.0	2,847.5	25.2		
trimethylbenzene, 1,2,4- (soil gas)	VLEACH1	56,439.0	19,962.0	5,479.3	1,164.1	490.2	93.5	N/A	
	VLEACH2	56,439.0	37,525.0	10,512.0	2,962.3	547.8	4.8		
vinyl chloride (soil)	VLEACH1	84.9	25.0	11.5	6.3	3.4	1.3	30	
	VLEACH2	8.5	2.5	1.2	0.6	0.3	0.1		
vinyl chloride (soil gas)	VLEACH1	21,035.0	6,187.5	2,850.5	1,548.9	845.8	312.7	N/A	
	VLEACH2	2,001.3	620.6	286.5	156.8	85.4	14.2		

**Table 1-1**  
**HHRA RAOs and WQSA Thresholds for VOCs in Soil and Soil Gas**

Contaminant	Model	WQSA Threshold for Given Maximum Depths of Contamination (µg/kg [soil], µg/L [soil gas])						HHRA RAOs (Residential Scenario)	
		Shallow			Deep				
		0-10'	10-20'	20-30'	30-40'	40-50'	50-60'		
xylene (soil)	VLEACH1	293,350.0	102,200.0	28,480.0	8,555.9	2,547.9	485.9	210,000	
	VLEACH2	293,350.0	195,050.0	54,641.0	15,397.0	2,847.5	25.2		
xylene (soil gas)	VLEACH1	56,439.0	19,962.0	5,479.3	1,646.1	450.2	93.5	4.8	
	VLEACH2	56,439.0	37,525.0	10,512.0	2,962.3	547.8	4.8		

**Footnotes**

- 1- WQSA thresholds represent levels considered protective of groundwater.
- HHRA RAOs represent levels considered protective of human health.
- VOC sites will be closed in accordance with the Castle AFB STOP process.

**Notes**

Shaded regions indicate soil gas RAOs

VLEACH1= Vadose Zone model with 1 ft mixing zone.

VLEACH2= Vadose model with no mixing zone.

DLM= California Water Board, Designated Level Methodology.

WQSA = Water quality site assessment

HHRA = Human health risk assessment

RAO = Remedial action objective

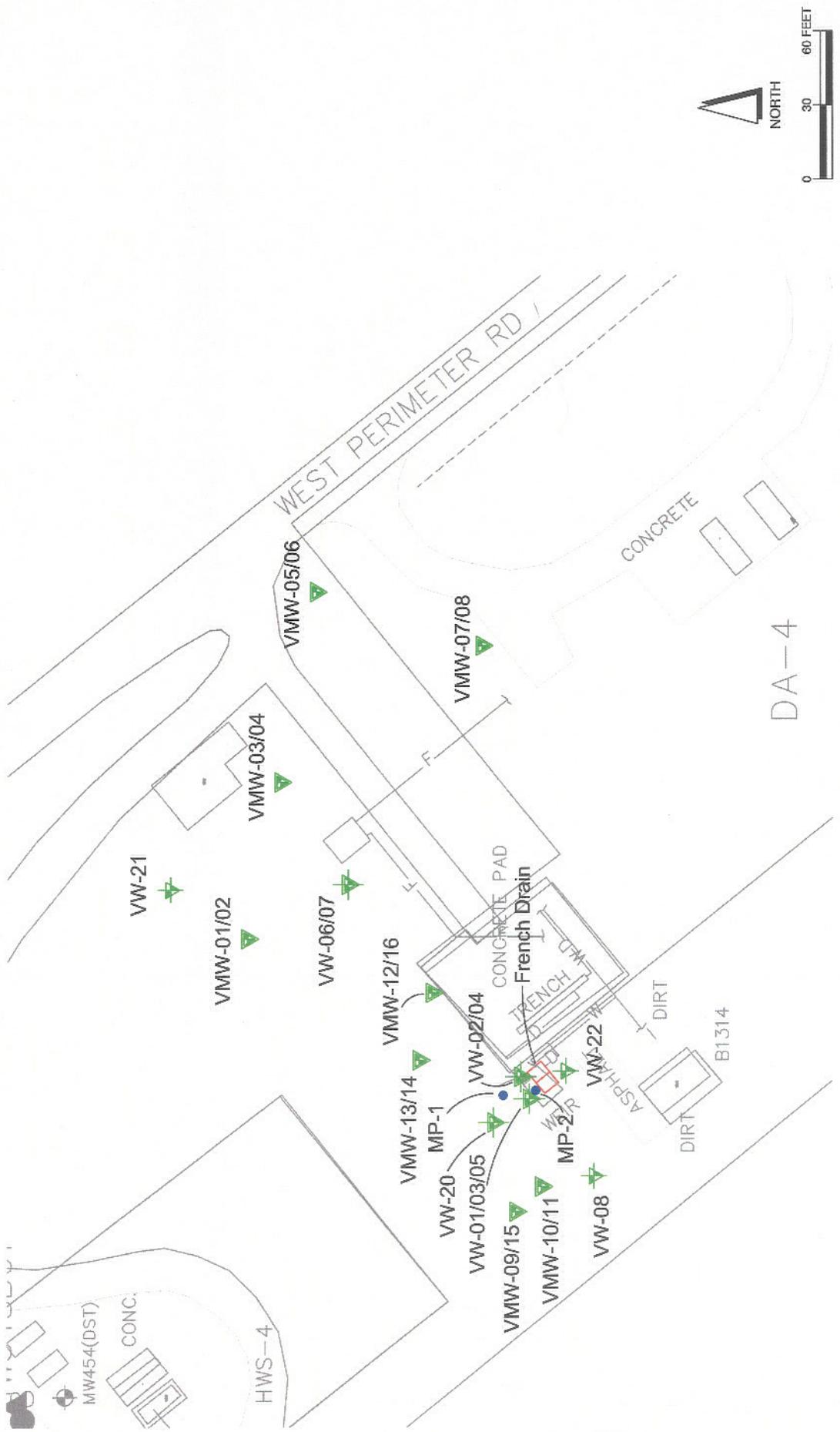
Source: Jacobs Engineering Group (JEG), 2001

## **2.0 PREVIOUS SOIL VAPOR EXTRACTION AT DA-4**

Previous site characterization and SVE activities resulted in the installation of 27 vapor wells and 2 monitoring points at DA-4. The vapor well and monitoring point locations are shown on Figure 2-1, and the screen intervals are listed on Table 2-1. A summary of the previous SVE efforts at DA-4 is provided below.

- SVE was initiated as a removal action in August 1996 and initially operated through January 1997 (JEG, 1998). Approximately 300 pounds of VOCs were removed. The *Action Memorandum* (USAF, 1995) and *Design Report* (JEG, 1996) were reviewed and approved by the BCT. TCE concentrations measured in August 1997 were below VLEACH1 WQSA thresholds but above VLEACH2 thresholds. A closure report was prepared but never finalized.
- SVE was performed for 60 days, and vertical profiling was performed using PneuLog™ in 1999 (Praxis Environmental Technologies [Praxis], 1999). Approximately 8 pounds of TCE were removed. TCE concentrations measured in June 1999 had rebounded significantly in the vicinity of VW01 and VW02, although they remained below VLEACH1 WQSA thresholds. Additional SVE was recommended.
- SVE was performed using 4 extraction wells for a period of 61 days during March and April 2001, and approximately 9 pounds of TCE were removed (Praxis, 2001). TCE concentrations measured in August 2001 were reduced considerably from the June 1999 concentrations; however, significant rebound continued in the vicinity of VW01 and VW02 upon termination of SVE.
- SVE was performed as a component of the SVE Decision Study (Earth Tech, 2003b) and consisted of two periods of SVE (November 2001 to April 2002, and June 2002 to November 2002) followed by rebound monitoring (April 2002 to June 2002, and November 2002 to March 2003). TCE soil gas concentrations were reduced significantly during SVE, and approximately 14 pounds of TCE were removed. At the end of the first SVE period (April 2002), TCE concentrations were below VLEACH2 WQSA thresholds in all but a single vapor well. At the end of the second SVE period (November 2002), TCE concentrations were below VLEACH2 WQSA thresholds in all vapor wells at DA-4. However, TCE concentrations rebounded substantially upon termination of SVE, most notably in the vicinity of the vault. TCE soil gas concentrations during final sampling in August 2003 exceeded VLEACH2 WQSA thresholds in VW-01, VW-02, VW-03, VW-05, VMW-04, MP-1, and

MP-2. Cis-1,2-DCE was detected above VLEACH2 WQSA thresholds in MP-2. Results of the SVE Decision Study are provided in detail in Section 3.



SCALE: 1" = 60'

0 30 60 FEET

### Vapor Well Locations

Vapor Well Locations	
Date: 08-04	Castle Airport
Project No. 79887	EARTH TEC H

A tyco INTERNATIONAL LTD. COMPANY

Table 2-1  
Vapor Well Screen Intervals

Well	Screen (feet bgs)
VW-01	10-15
VW-02	17-22
VW-03	24-29
VW-04	32-42
VW-05	56-66
VW-06	10-15
VW-07	22-42
VW-08	24-29
VW-20	10-65
VW-21	10-65
VW-22	5-20
VMW-01	10-15
VMW-02	22-42
VMW-03	10-15
VMW-04	22-42
VMW-05	56-66
VMW-06	22-42
VMW-07	10-15
VMW-08	23-43
VMW-09	9-14
VMW-10	17-22
VMW-11	32-42
VMW-12	10-15
VMW-13	17-22
VMW-14	31-41
VMW-15	25-30
VMW-16	55-65
MP-1	5-8
MP-2	5-8

Notes:

bgs = below ground surface

### **3.0 SVE DECISION STUDY RESULTS**

Comprehensive vapor sampling was conducted in August 2003 to provide an updated characterization of soil vapor concentrations at DA-4. Vapor samples were collected from all 29 vapor wells and monitoring points and analyzed with a field gas chromatograph (GC) for TCE and cis-1,2-DCE. Additionally, vapor samples from the 10 vapor wells and monitoring points with previous TCE detections in excess of VLEACH2 thresholds were collected using SUMMA canisters and analyzed at a laboratory for VOCs according to EPA Method TO-14. The results of the GC analyses are summarized on Table 3-1, and the results of the TO-14 analyses are summarized on Table 3-2.

TCE soil gas concentrations exceeded VLEACH2 WQSA thresholds in VW-01, VW-02, VW-03, VW-05, VMW-4, VMW-16, MP-1, and MP-2 in August 2003. Cis-1,2-DCE exceeded the VLEACH2 threshold in MP-2. Plots of August 2003 TCE soil gas concentrations for depth intervals 0 to 20 feet bgs, 20 to 45 feet bgs, and 45 to 65 feet bgs are shown on Figures 3-1, 3-2, and 3-3, respectively. Laboratory results were used for vapor wells with both field GC and laboratory analyses.

The SVE Decision Study also included an evaluation of indoor air risk using the Johnson and Ettinger model (U.S. EPA, 2000). The evaluation indicated that VOC concentrations measured in August 2003 posed a potential adverse risk to human health via the indoor inhalation exposure pathway, assuming a building is constructed directly above the source area.

The *SVE Decision Study Data Report* (Earth Tech, 2003b) for DA-4 concluded that the majority of residual VOCs were shallow and would not be effectively removed by continued SVE due to vapor flow limitations caused primarily by the concrete vault. The report recommended excavation of the source area (i.e., concrete vault) and subsequent SVE to remove residual VOCs, consistent with the selected remedy for DA-4 established in the SCOU ROD Part 2.

**Table 3-1**  
**Field Sampling Results (TCE and cis-1,2-DCE)**  
**August 2003**

Well	Screen	cis-1,2-DCE	TCE
VMW-05	56-66	ND	ND
VMW-01	10-15	ND	0.1
VMW-02	22-42	ND	0.3
VW-21	10-65	ND	0.3
VMW-07	10-15	ND	0.1
VMW-03	10-15	ND	1.3
VMW-04	22-42	ND	<b>16.5 (4.8)</b>
VMW-06	22-42	ND	0.6
VMW-08	23-43	ND	0.4
VW-06	10-15	ND	0.7
VW-07	22-42	ND	2.9
VW-20	10-65	3.4	60.9
VW-22	5-20	0.2	10.1
VW-05	56-66	0.3	<b>8.4 (1.8)</b>
VW-04	32-42	ND	0.8
VW-03	24-29	0.1	<b>84.8 (10.6)</b>
VW-02	17-22	0.2	<b>281.5 (10.6)</b>
VW-01	10-15	16.0	<b>276.7 (19.0)</b>
MP-1	5-10	35.9	<b>199.4 (49.6)</b>
MP-2	5-10	<b>438.1 (40.7)</b>	<b>1480 (49.6)</b>
MP-2 (dup)	5-10	<b>437.8 (40.7)</b>	<b>1478 (49.6)</b>
VMW-12	10-15	ND	0.2
VMW-16	55-65	0.1	<b>3.7 (1.8)</b>
VMW-13	17-22	ND	3.4
VMW-14	31-41	ND	2.3
VMW-09	9-14	ND	ND
VMW-15	25-30	ND	ND
VMW-10	17-22	ND	0.2
VMW-11	32-42	ND	0.2
VW-08	24-29	ND	ND
VW-08 (dup)	24-29	ND	ND

Notes:

All samples analyzed with field gas chromatograph

All concentrations in micrograms per liter (ug/L)

**bold** indicates concentration in excess of VLEACH2 WQSA threshold

VLEACH2 threshold applicable to the bottom of screen is provided in parentheses

ND = not detected

**Table 3-2**  
**August 2003 VOC Concentrations**

Compound	VW-21	VMW-03	VMW-04	VW-05	VW-03	VW-01	VW-04	VW-02	MP-1	MP-2
4-ethyltoluene	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-trimethylbenzene	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-dichloroethene (DCE)	ND	ND	ND	0.22	ND	8.70	0.01	ND	20	<b>210</b> (40.7)
trichloroethene (TCE)	0.64	1.30	<b>20</b> (4.8)	<b>7.5</b> (1.8)	<b>64</b> (10.6)	<b>190</b> (19.0)	0.91	<b>200</b> (10.6)	<b>140</b> (49.6)	<b>920</b> (49.6)
tetrachloroethene (PCE)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
toluene	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND
xlenes (m-p-)	0.01	0.02	ND	ND	ND	ND	ND	ND	ND	ND
non-methane hydrocarbons	ND	2	28	10	92	290	ND	290	230	1500

*Notes:*

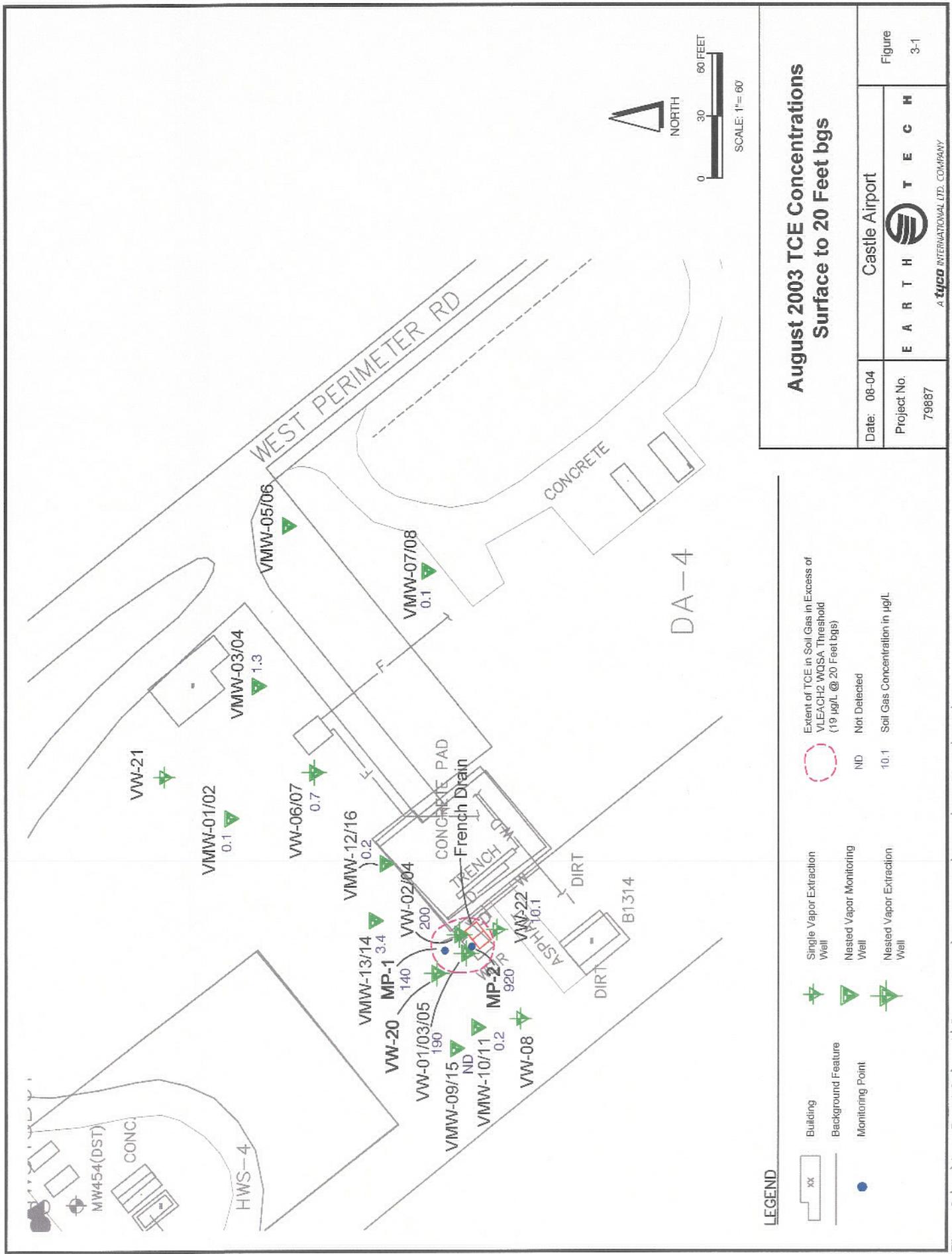
Analyses performed by Severn Trent Laboratories according to EPA Method TO-14

All concentrations given in µg/L

ND = not detected

Sampling Date: August 2003

**bold** indicates concentration in excess of VLEACH2 WQSA threshold provided in parentheses for bottom of screen



**August 2003 TCE Concentrations  
Surface to 20 Feet bgs**

Extent of TCE in Soil Gas in Excess of  
VLEACH2 WQSA Threshold  
(19 µg/L @ 20 Feet bgs)

ND Not Detected

10.1 Soil Gas Concentration in µg/L

August 2003 TCE Concentrations Surface to 20 Feet bgs		Figure
Date: 08-04	Castle Airport	3-1

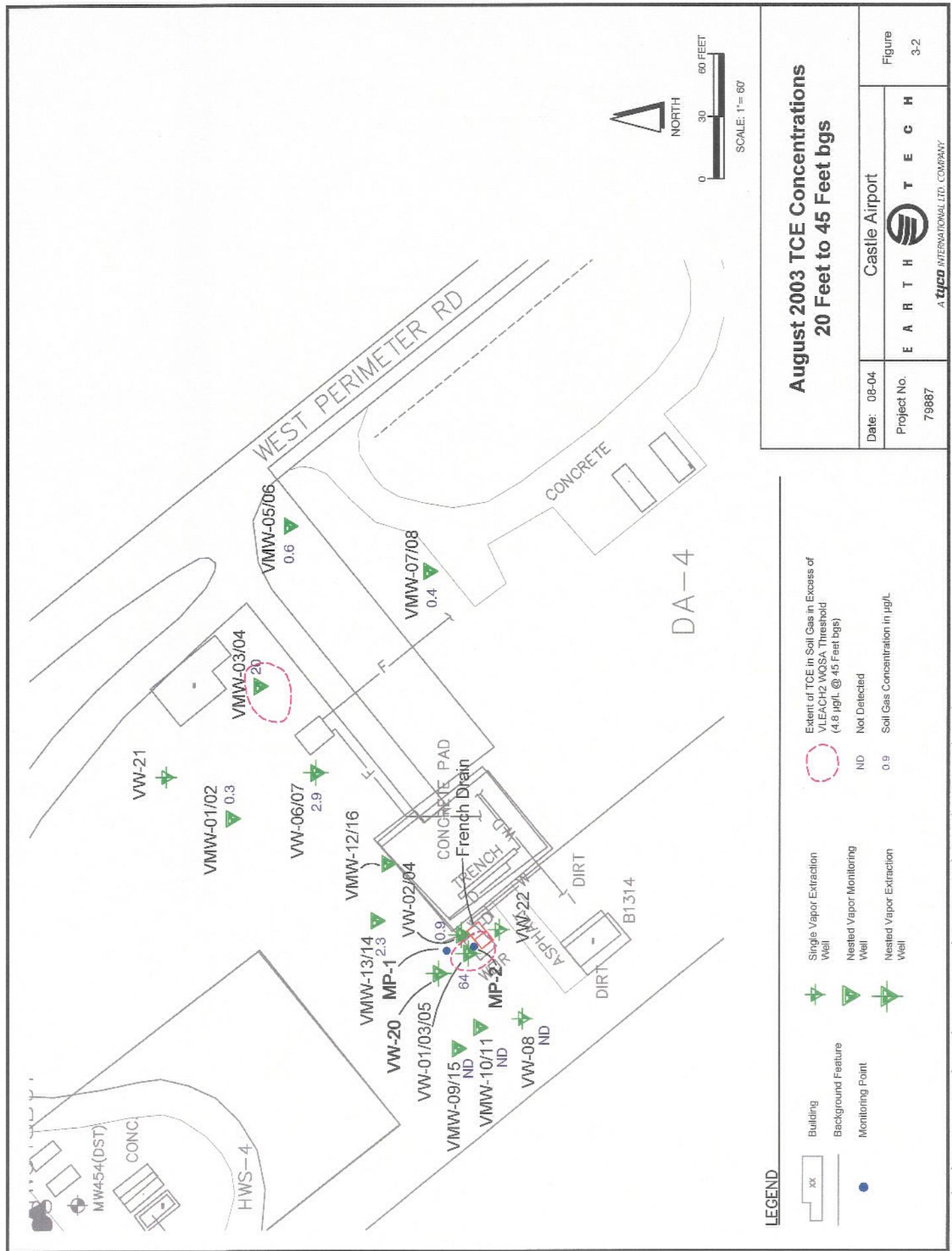
Project No. 79887 EARTH TECH



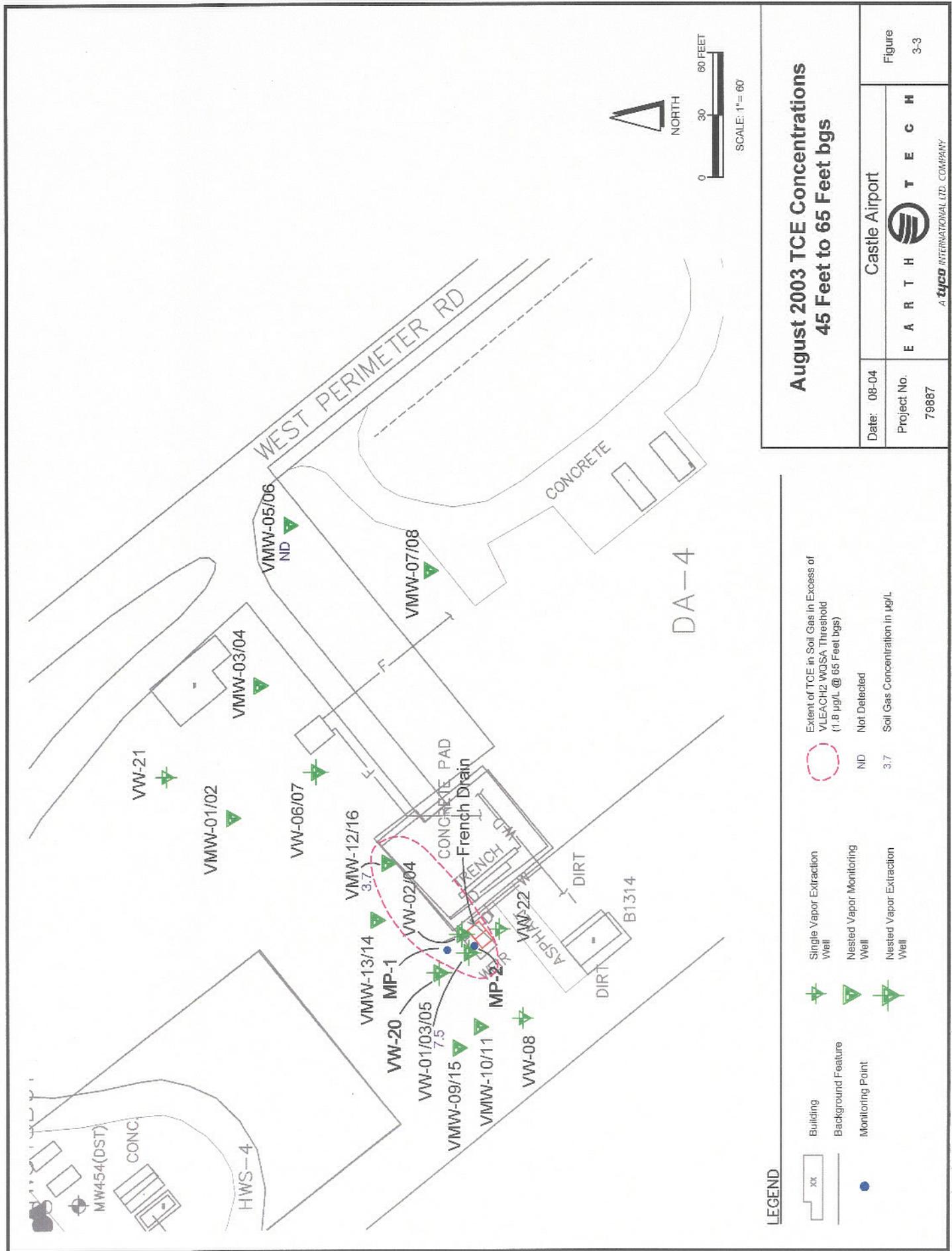
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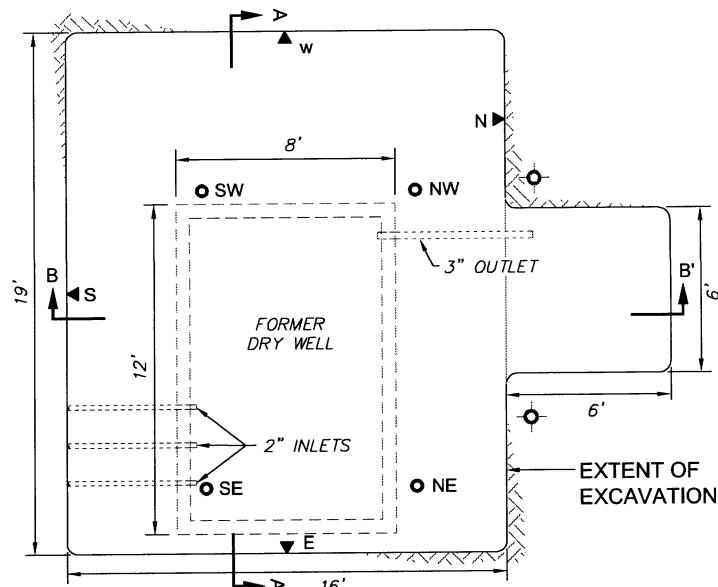
## **4.0 SELECTED REMEDY IMPLEMENTATION**

Soil excavation and SVE were implemented at DA-4 in accordance with the strategy presented in the *Remedial Action Work Plan* (Earth Tech, 2004). A description of remedy implementation and results is provided in the following subsections.

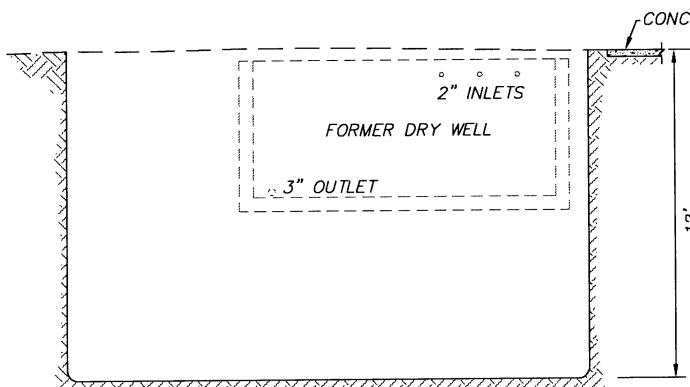
### **4.1 EXCAVATION**

The concrete vault, also previously referred to as a French drain or dry well, and associated contaminated soil were excavated on October 20 and 21, 2004. The top of the vault was located within 6 inches of the ground surface. The vault had dimensions of 12 feet by 8 feet and a depth of 6 feet (Figure 4-1), and appeared to have been constructed in two phases. The lower half was constructed first, and consisted of 10-inch reinforced concrete sidewalls and an 18-inch reinforced concrete base. The upper half consisted of 8-inch reinforced concrete sidewalls with a 1-inch non-reinforced concrete cover. The cover was sloped towards an opening on the western side, which drained into the main tank below. Three 2-inch inlets were present on the upper southeast wall. The center inlet was connected to a drain present on the surface of the concrete pad, and rainwater was flowing into the dry well during the excavation. The sources of the other inlets were not apparent, but they likely were connected to other surface drains. A 3-inch outlet was present at the base of the northwest corner of the vault. A five feet long section of 3-inch diameter tar paper pipe extended from the outlet towards the northwest. The tar paper pipe was removed and water was flowing from the outlet during excavation. Based on observations during vault excavation and demolition, water flowed through the vault during periods of appreciable precipitation, and discharged to the soil from the northwest outlet.

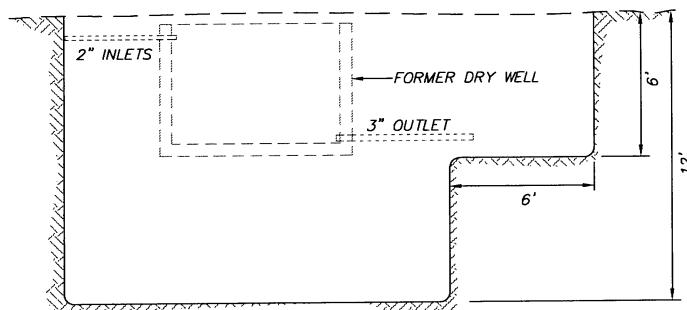
The cover of the vault was removed, revealing the main tank filled with soil and debris. The soil and debris were removed and stockpiled, and the vault was demolished in place using a pneumatic hammer. The demolished concrete was removed and the contaminated soil underneath and adjacent to the vault was excavated and stockpiled, including the tar paper conduit from the outlet drain. Samples of soil from the backhoe bucket were monitored with a photo-ionization detector (PID) during the excavation. The maximum detected VOC concentration was approximately 2,500 parts per million directly beneath the vault. Additionally, the soil 1 to 2 feet directly below the vault was visibly darker than the surrounding soil. The excavation was continued until VOCs were no longer detected with the PID from any portion of the sidewalls or bottom. The final excavation dimensions were approximately 19 feet by 16 feet, with a depth of 12 feet.



PLAN



CROSS-SECTION A-A'



CROSS-SECTION B-B'

0 4 8 FEET  
SCALE: 1" = 8'

LEGEND:

- NW ● BOTTOM SAMPLE COLLECTION POINT
- N ► SIDEWALL SAMPLE COLLECTION POINT
- EXISTING VAPOR EXTRACTION WELL

**DA-4 Excavation Details**

Date: 07-05

Castle Airport

Project No.  
79887

**EarthTech**  
A Tyco International Ltd. Company

Figure  
4-1

An adjacent excavation of approximately 6 feet by 6 feet by 6 feet deep was completed to remove the outlet conduit. No vapor wells were damaged or destroyed during the excavation, although two monitoring probes (MP-1 and MP-2) were excavated. The total excavated volume was approximately 145 cubic yards.

Based on PID measurement, soil with VOCs was stockpiled separately from soil without VOCs. Composite samples were collected from each stockpile and analyzed for VOCs at Castle Analytical Laboratory located on the former Base. VOCs detected in the composite sample from the “contaminated” stockpile included TCE (6.0 mg/kg), cis-1,2-DCE (0.091 mg/kg) and 1,2,4-trimethylbenzene (0.012 mg/kg). TCE was detected at a concentration of 0.052 mg/kg in the other stockpile composite sample; no other VOCs were detected. The laboratory report is provided in Appendix A. All excavated soil was classified as non-hazardous based on waste profiling using the analytical results. The soil, debris, and concrete were disposed at Forward Landfill in Manteca, California. The non-hazardous waste data forms are provided in Appendix B.

Confirmation soil samples were collected from the base and sidewalls of the excavation. Four samples were collected from the base of the excavation at a depth of 12 feet (B-NW-12, B-NE-12, B-SE-12, B-SW-12), and one sample was collected from each sidewall at a depth of 6 feet (SW-W-6, SW-N-6, SW-S-6, SW-E-6). The samples were analyzed for VOCs (SW8260) at Castle Analytical Laboratory and the results are summarized on Table 4-1. TCE was detected in one bottom sample and three sidewall samples. The TCE concentrations in SW-N-6 (0.21 mg/kg) and SW-S-6 (0.15 mg/kg) were above the VLEACH2 WQSA threshold (0.02 mg/kg). Based on the relatively low detected concentrations and the plan for additional SVE, the excavation was backfilled with clean soil and compacted to original grade upon completion of confirmation sampling. Photographs of the excavation, demolition, and backfilling are provided in Appendix C.

## **4.2 SOIL VAPOR EXTRACTION**

### **4.2.1 BASELINE FIELD SCREENING**

All vapor wells at DA-4 were sampled on October 20, 2005 and analyzed for TCE using a field GC to establish baseline conditions prior to excavation and SVE. The field-measured TCE concentrations are listed on Table 4-2 and range from <1 µg/L in several wells to 1,800 µg/L in MP-1. Consistent with previous sampling results at DA-4, the highest concentrations were measured in shallow soils (less than 25 feet bgs) in the vicinity of the subsurface vault. The concentrations were higher than the previous sampling conducted in August 2003,

**Table 4-1**  
**Confirmation Sampling Results**

Compound	Bottom (NW)	Bottom (NE)	Bottom (SE)	Bottom (SW)	Sidewall (W)	Sidewall (N)	Sidewall (S)	Sidewall (E)
TCE	ND	0.02	ND	ND	ND	0.21	0.15	0.01
cis-1,2-DCE	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

Analyses performed according to EPA Method 8260 (VOCs)

All concentrations given in mg/kg

ND = not detected

Sampling Date: October 21, 2004

VLEACH1 WQSA thresholds for TCE in soil are 2.7 mg/kg and 1.0 mg/kg, respectively for 0-10 feet bgs and 10-20 feet bgs

VLEACH2 WQSA thresholds for TCE in soil are .05 mg/kg and .02 mg/kg, respectively for 0-10 feet bgs and 10-20 feet bgs

**Table 4-2**  
**Pre-Excavation TCE Concentrations**  
**October 2004**

Well	TCE
VW-01	460
VW-02	170
VW-03	126
VW-04	0.4
VW-05	23
VW-06	4
VW-07	9
VW-08	0.4
VW-20	42
VW-21	2
VW-22	67
VMW-01	0.4
VMW-02	2
VMW-03	8
VMW-04	36
VMW-05	0.2
VMW-06	0.7
VMW-09	0.6
VMW-10	3
VMW-11	3
VMW-12	2
VMW-13	14
VMW-14	9
VMW-16	13
MP-1	1,800
MP-2	150

Notes:

All samples analyzed with field gas chromatograph

All concentrations in micrograms per liter (ug/L)

indicating the presence of a continuing VOC source, and confirming the need for further remedy implementation.

#### **4.2.2 SVE AND REBOUND EVALUATION**

SVE was initiated on October 26, 2004 from VW-01 using a positive displacement blower. Extraction from VW-01 continued until November 28, 2004 at an average flow rate of approximately 100 standard cubic feet per minute (scfm). On November 28, 2004, TCE concentrations in the source area wells were below VLEACH2 thresholds. Extraction was terminated from VW-01 on November 28, 2004, and initiated from VW-03 and VW-04 to evaluate mass removal from deeper soils (greater than 25 feet bgs). Extraction continued from VW-03 and VW-04 until December 10, 2004. Average flow rates were approximately 12 scfm from VW-03, and 75 scfm from VW-04. SVE was terminated on December 10, 2004, and concentrations were monitored in the source area to evaluate rebound. TCE concentrations had increased above VLEACH2 thresholds in VW-01 (45 µg/L) and VW-02 (58 µg/L) by December 28, 2004.

SVE was restarted from VW-02 on December 28, 2004 at an average flow rate of approximately 100 scfm. TCE concentrations were below VLEACH2 thresholds in VW-01 and VW-02 by January 6, 2005. SVE was continued from VW-02 until January 18, 2005. SVE was terminated on January 18, 2005 for a second rebound evaluation period. By March 3, 2005, the TCE concentration in VW-02 (47 µg/L) had increased above the VLEACH2 threshold. SVE was restarted at VW-02 on March 9, 2005, and TCE concentrations were reduced below the VLEACH2 thresholds on April 6, 2005. SVE was terminated on April 6, 2005 for final rebound evaluation.

The estimated cumulative mass of TCE removed during post-excavation SVE is 4.7 pounds. Totals for individual extraction wells are as follows: VW-01 = 2.2 lbs, VW-02 = 2.1 lbs, VW-03 0.05 lbs, and VW-04 0.3 lbs.

As specified in *SCOUR ROD Part 2*, treatment of extracted vapors is not required if the VOC emissions do not exceed a total of 2 pounds per day [San Joaquin Valley Unified Air Pollution Control District Rule 2201, Section 4.1]. Based on field monitoring results and flow rates, total daily VOC emissions did not exceed 2 pounds per day. The maximum estimated daily mass removal rate was 0.9 pound on October 26, 2004. The rate decreased to less than 0.1 pound per day by October 28, 2004. Similarly, emission rates measured at

startup on December 12, 2004 and March 9, 2005 decreased swiftly as concentrations dropped significantly within a few hours of extraction.

#### **4.2.3 FINAL VAPOR SAMPLING**

In accordance with the *Remedial Action Work Plan* (Earth Tech, 2004), confirmation vapor samples were collected in SUMMA canisters at the end of a 60-day rebound period from the following wells: VW-01, VW-02, VW-03, VW-05, VMW-04, and VMW-16. The samples were collected on June 8, 2005 and analyzed for VOCs (TO-14) by Severn Trent Laboratories (STL). The results are summarized on Table 4-3, and the laboratory report is provided in Appendix A. Plots of June 2005 TCE soil gas concentrations for depth intervals 0 to 20 feet bgs, 20 to 45 feet bgs, and 45 to 65 feet bgs are shown on Figures 4-2, 4-3, and 4-4, respectively.

TCE concentrations from the source area vapor wells (VW-01, VW-02, VW-03, VW-04, and VW-05) from October 26, 2004 through June 8, 2005 are depicted graphically on Figure 4-5. Figure 4-5 demonstrates the substantial decrease in TCE concentrations at DA-4 as a result of remedy implementation. Table 4-4 lists the pre-remedy (October 2004) versus post-remedy (June 2005) TCE concentrations in the source area. On average, TCE concentrations in the source area were reduced greater than 90 percent after excavation and SVE, confirming that the primary source of VOCs has been removed.

**Table 4-3**  
**Final VOC Concentrations**  
**June 2005**

Compound	VW-01	VW-02	VW-03	VW-05	VMW-04	VMW-16
cis-1,2-dichloroethene (DCE)	ND	ND	0.03	0.02	ND	0.04
trichloroethene (TCE)	<b>38</b> (19)	<b>33</b> (10.6)	5.8	0.8	<b>20</b> (4.8)	<b>2.4</b> (1.8)
non-methane hydrocarbons	6,500	5,400	1,100	160	3,400	430

Notes:

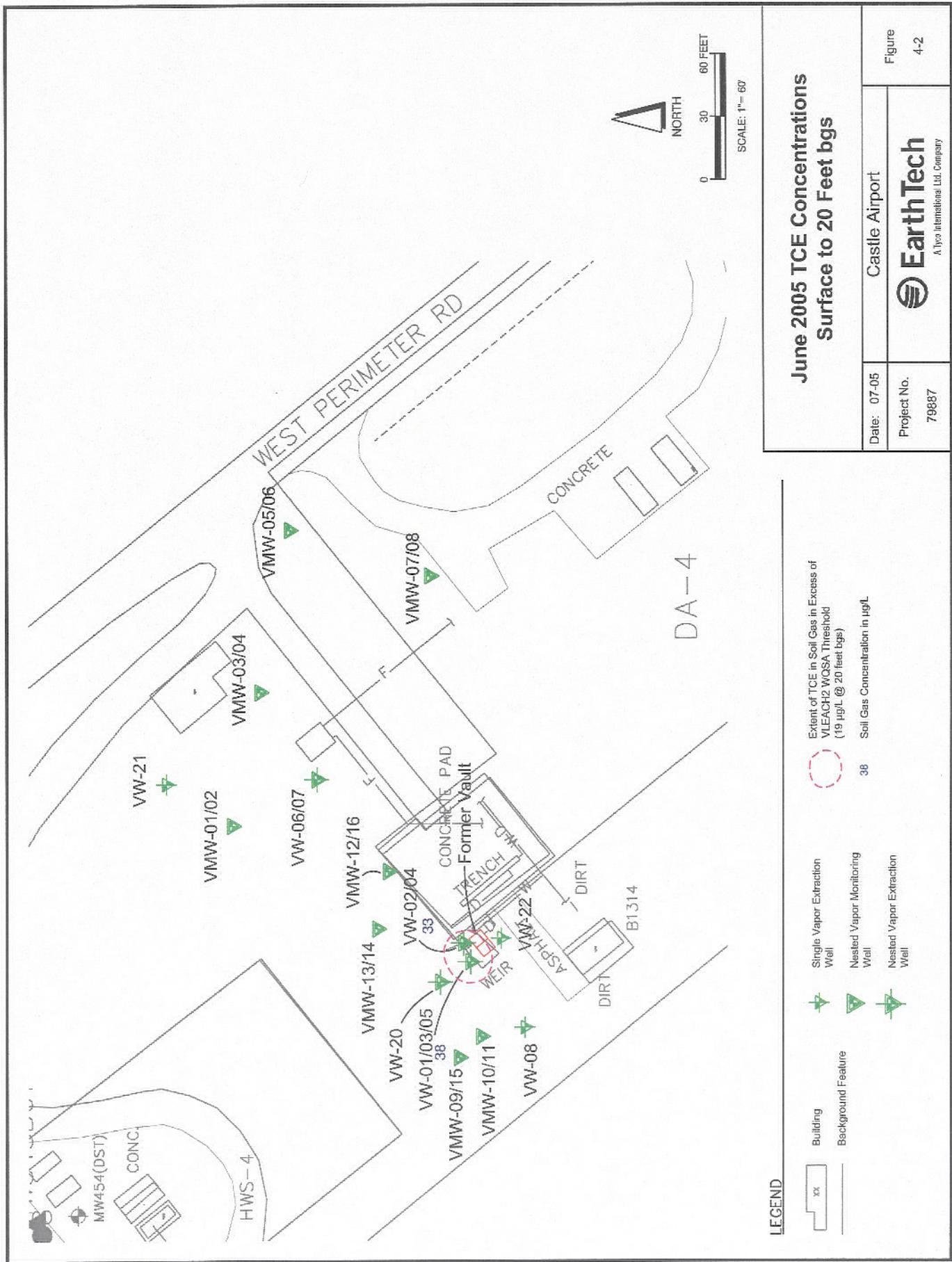
Analyses performed by Severn Trent Laboratories according to EPA Method TO-14

All concentrations given in µg/L

ND = not detected

Sampling Date: June 8, 2005

**bold** indicates concentration in excess of VLEACH2 WQSA threshold provided in parentheses for bottom of screen

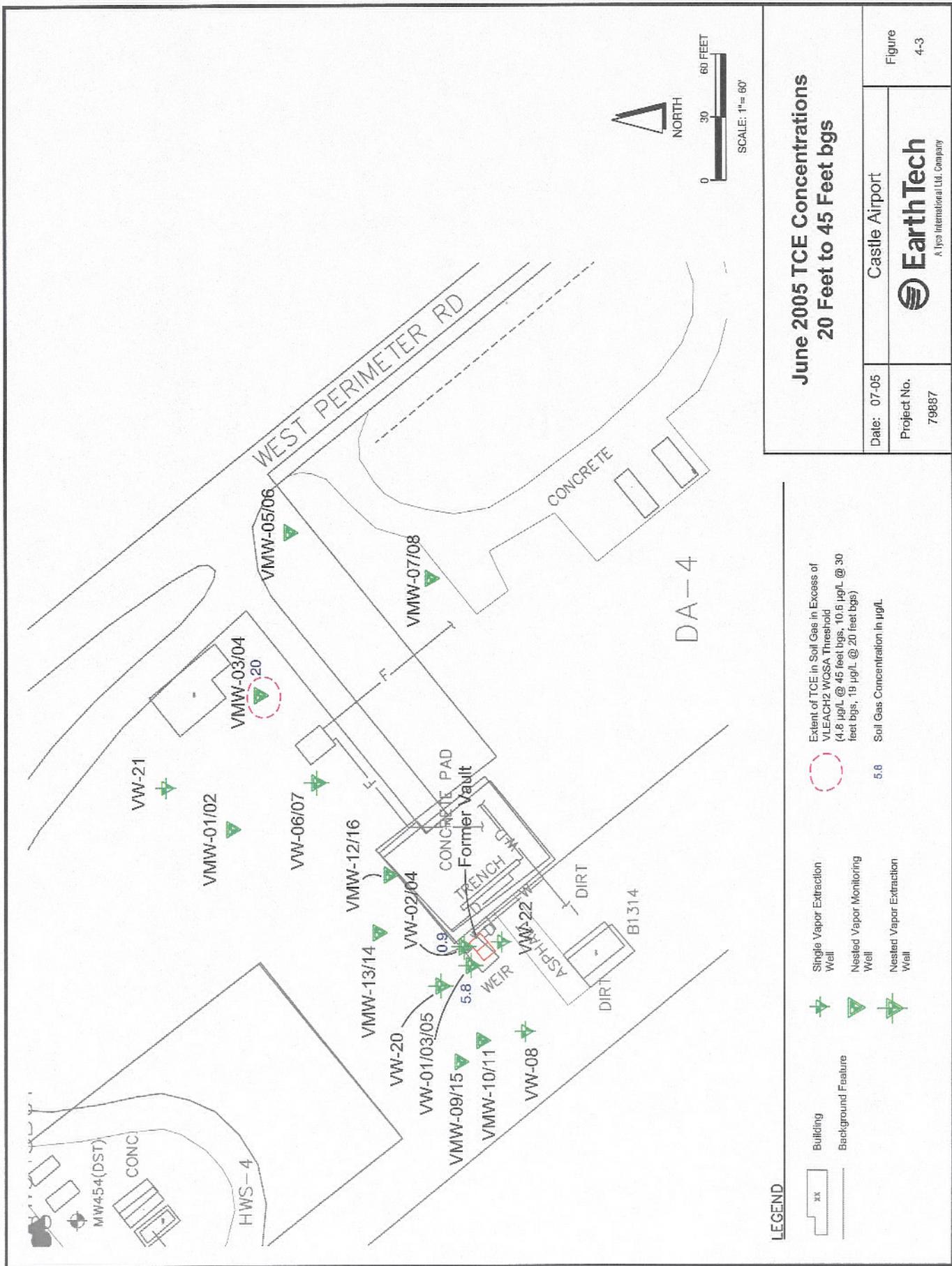


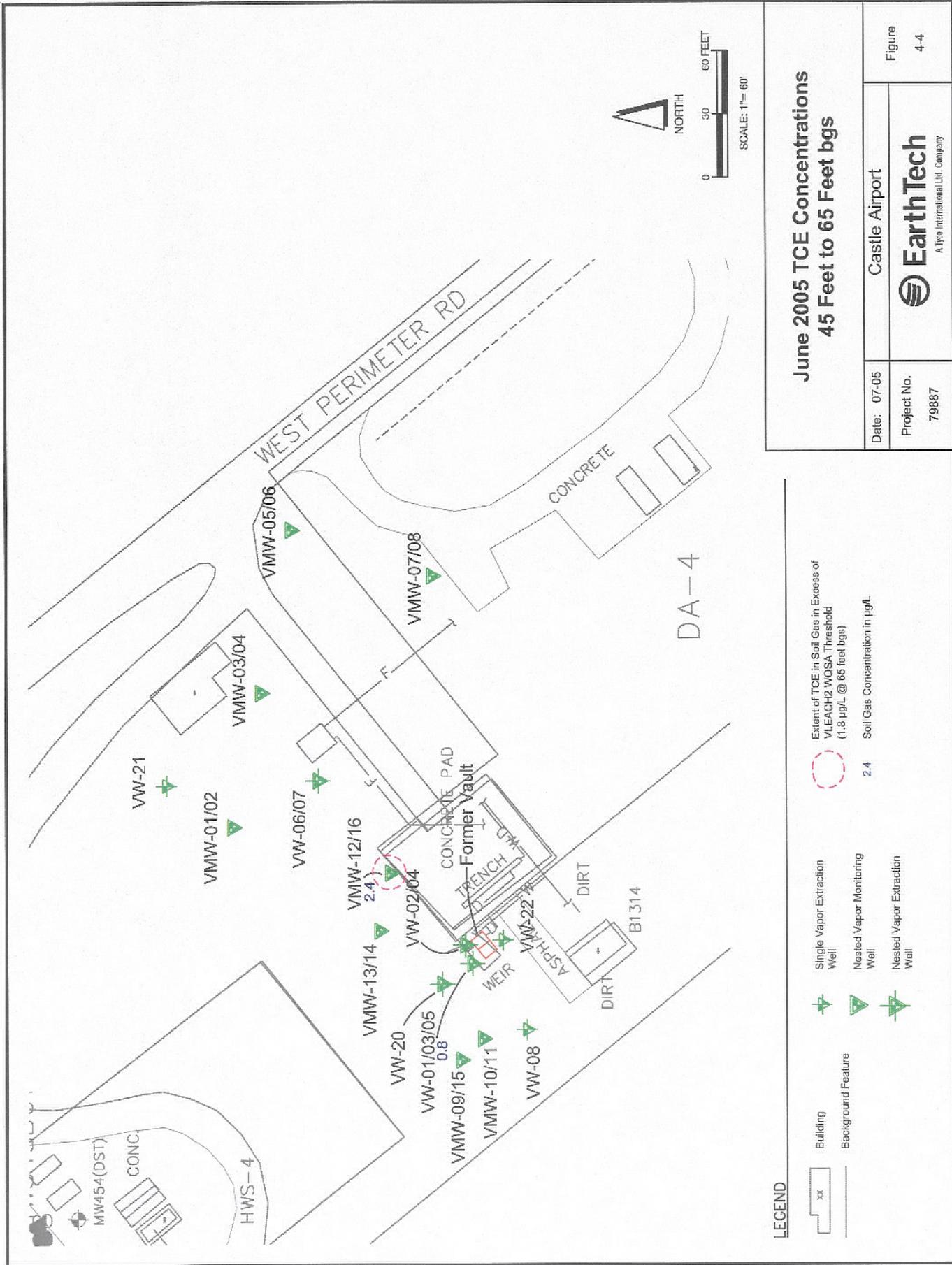
### June 2005 TCE Concentrations Surface to 20 Feet bgs

Project No.	79887	Castle Airport	Figure 4-2
Date:	07-05	EarthTech A Tyco International Ltd. Company	

Extent of TCE in Soil Gas in Excess of VLEACH2 WOSA Threshold (19 µg/L @ 20 feet bgs)  
38 Soil Gas Concentration in µg/L

Single Vapor Extraction Well  
Nested Vapor Monitoring Well  
Nested Vapor Extraction Well





### June 2005 TCE Concentrations 45 Feet to 65 Feet bgs

Date: 07-05	Project No. 79887	Castle Airport	Figure 4-4
		EarthTech A IFC International Ltd. Company	

**Figure 4-5**  
**TCE Concentrations During SVE**

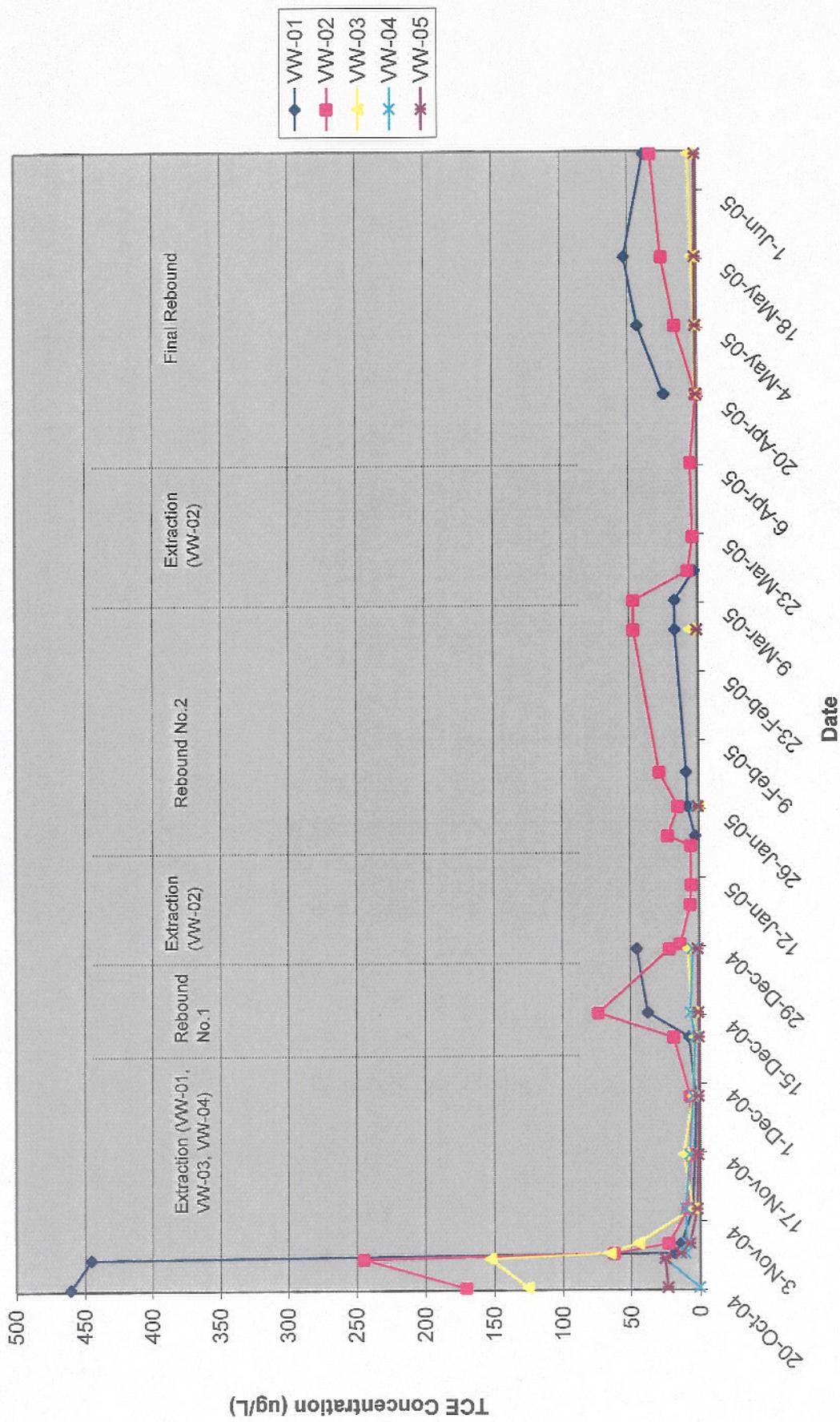


Table 4-5: Source Area TCE Concentration Reductions

Well	pre-remedy	post-remedy	reduction
VW-01	460 µg/L	38 µg/L	92%
VW-02	170 µg/L	33 µg/L	81%
VW-03	126 µg/L	5.8 µg/L	95%
VW-05	23 µg/L	0.8 µg/L	97%
MP-1	1,800 µg/L	excavated	----
MP-2	150 µg/L	excavated	----

## 5.0 INDOOR AIR QUALITY

Indoor air quality was evaluated at DA-4 in accordance with the *Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (Cal-EPA, 2004). An initial screening evaluation was performed as detailed in Appendix D. The screening evaluation conservatively applies the maximum soil gas concentration as representative of the entire site. The estimated excess cancer risk due to residual TCE via the indoor air inhalation pathway based on the screening evaluation is 3E-05. Since the excess risk exceeded 1E-06, a site-specific evaluation was performed using the Cal-EPA Johnson and Ettinger (J&E) model (Cal-EPA, 2003) as specified in the guidance document. The model incorporates convective and diffusive mechanisms for estimating the transport of vapors emanating from subsurface soils into indoor spaces located directly above residual contamination. Input parameters include contaminant physicochemical characteristics, soil properties and depths, VOC concentrations, exposure durations, and physical attributes of the building(s) present or presumed at the site. The model estimates the potential risk attributed to each contaminant via the indoor inhalation exposure pathway.

Input parameters used for the site-specific evaluation are provided on Table 5-1. Site-specific soil properties, TCE concentrations, and building dimensions were used, and conservative default values were used for the remaining input parameters. The model computes a risk value for carcinogenic compounds, and a hazard quotient for non-carcinogenic compounds. Two evaluations were performed; one using an average TCE concentration, and another using the maximum TCE concentration based on June 2005 measurements.

The average TCE concentration of 15.6 µg/L was calculated using the June 2005 (Table 4-3) TCE concentrations in the source area vapor wells (VW-01, VW-02, VW-03, VW-04, VW-05; since VW-04 was not sampled in June 2005, a pre-SVE concentration of 0.4 µg/L was used). The maximum June 2005 TCE concentration of 38 µg/L was measured in VW-01 (Table 4-3). The computed cumulative carcinogenic risk resulting from the average measured residual TCE at DA-4 via the indoor inhalation exposure pathway is 6E-07, and the hazard quotient is 0.001. The computed cumulative carcinogenic risk resulting from the maximum measured residual TCE concentration at DA-4 via the indoor inhalation exposure pathway is 2E-06, and the hazard quotient is 0.003. Based on these results, residual TCE concentrations at DA-4 do not represent an adverse threat to human health via the indoor inhalation exposure pathway. Spreadsheets detailing the J&E risk computations are provided in Appendix D.

Table 5-1: Johnson and Ettinger Model Input Parameters

Parameter	Value
Soil gas depth	65 feet
Soil vapor permeability	1.0E-08 cm <sup>2</sup>
Dry bulk density	1.47 g/cm <sup>3</sup>
Total porosity	0.45
Water-filled porosity	0.166
Building length	70 feet
Building width	70 feet
Building height	10 feet
Floor thickness	0.5 feet
Soil-building pressure differential*	40 g/cm-s <sup>2</sup>
Floor-wall seam crack width*	0.1 cm
Indoor air exchange rate*	0.45/hour
Averaging time for carcinogens*	70 years
Averaging time for non-carcinogens*	30 years
Exposure duration*	30 years
Exposure frequency*	350 days/year

Notes:

\* Denotes parameter for which the default input value was used.

cm = centimeter

g = gram

s = second

## **6.0 VLEACH SCREENING**

TCE was detected in excess of the VLEACH2 WQSA thresholds in soil gas at DA-4 in June 2005. A screening using VLEACH (Ravi and Johnson, 1997) was conducted to assess potential leachate concentrations to groundwater in accordance with the STOP evaluation. The VLEACH screening was performed to fulfill the elements of STOP decision criteria I and II described in Section 1.4.

### **6.1 MODEL DESCRIPTION**

VLEACH is a one-dimensional, finite difference transport model that simulates the leaching of a contaminant from the vadose zone to groundwater. VLEACH describes the movement of an organic compound within and between three phases: (1) as an aqueous solute, (2) as a gas, and (3) as an adsorbed solid. Equilibration between phases occurs according to distribution coefficients unique to the compound. In particular, VLEACH simulates vertical transport by advection in the liquid phase and by gaseous diffusion in the vapor phase.

VLEACH simulations are conceptualized as occurring in a number of distinct, user-defined polygons. Each polygon is vertically divided into a series of user-defined cells. The polygons may differ in soil properties, infiltration rate, and depth. However, homogeneous conditions are assumed within each polygon except for contaminant concentration, which can vary between cells. Therefore, VLEACH can account for lateral homogeneity but is limited when simulating vertical heterogeneity of soil properties. In addition, VLEACH neglects liquid phase dispersion, resulting in higher dissolved concentrations and lower travel times than actual.

### **6.2 VLEACH INPUT**

The input parameters for VLEACH consist of physicochemical characteristics of the contaminant, soil properties, and depth-specific contaminant concentrations. The physicochemical characteristics of the contaminant include the organic carbon distribution coefficient, Henry's constant, aqueous solubility, and free air diffusion coefficient.

The soil properties include dry bulk density, porosity, water content, and fraction organic carbon, polygon area, vertical cell dimension, and initial concentration. Infiltration due to precipitation is input to VLEACH and serves as the primary mechanism of contaminant migration. The infiltration rate was established in the *SCOU*

*RI/FS* (JEG, 1997a) as 0.2842 feet/year. Table 6-1 presents the VLEACH input parameters used for the screening evaluation.

Soil properties directly measured at similar CAFB VOC sites were used for input. The VLEACH screening used three polygons, each representing a vapor well with a TCE concentration in excess of the VLEACH2 WQSA threshold. The areas and distribution of the polygons are presented in Appendix E. The polygons were vertically discretized into cells 5 feet thick, and assigned the TCE concentration measured in June 2005, at depths coincident with the applicable screen depth. The TCE vapor concentrations were converted into soil concentrations for input to VLEACH using the soil gas equilibrium equation:

$$C_t = C_g / \rho_b [(\rho_b K_d / K_h) + (\theta / K_h) + (n - \theta)]$$

Where:

$C_t$  = total soil VOC concentration ( $\mu\text{g}/\text{kg}$ )

$C_g$  = soil vapor concentration ( $\mu\text{g}/\text{L}$ )

$\rho_b$  = soil bulk density ( $\text{g}/\text{cm}^3$ )

$K_d$  = distribution coefficient for soil-water partitioning ( $\text{ml/g}$ )

$K_h$  = Henry's constant for air-water partitioning (dimensionless)

$n$  = total soil porosity (dimensionless)

$\theta$  = water filled porosity (dimensionless)

Cells were assigned TCE concentrations corresponding to their respective depth intervals; cells not directly coincident with a screen were assigned averages of the screens located above and below. Cell concentrations are presented in Table 6-1.

Table 6-1  
VLEACH Input Data for DA-4

Parameter	Polygon 1 (VMW01, VMW02)	Polygon 1 (VMW01, VMW02)	Polygon 2 (VMW04)	Polygon 3 (VMW16)
Organic Carbon Coefficient (milliliters per gram)	125.89	125.89	125.89	125.89
Henry's Constant (dimensionless)	0.363	0.363	0.363	0.363
Solubility (milligrams per liter)	1000	1000	1000	1000
Free Air Diffusion Coefficient (square meters per day)	0.7	0.7	0.7	0.7
Area (square feet)	1,964	1,964	1,964	1,964
Vertical Cell Dimension (feet)	1	1	1	1
Recharge Rate (feet per year)	0.2842	0.2842	0.2842	0.2842
Dry Bulk Density <sup>(1)</sup> (grams per cubic centimeter)	1.79	1.4	1.4	1.4
Effective Porosity <sup>(1)</sup> (percent)	0.316	0.3	0.3	0.3
Volumetric Water Content <sup>(1)</sup> (percent)	0.137	0.137	0.137	0.137
Fraction Organic Carbon <sup>(1)</sup> (percent)	0.002	0.002	0.002	0.002
TCE Concentration Input	Depth (feet)	TCE ( $\mu\text{g}/\text{kg}$ )	Depth (feet)	TCE ( $\mu\text{g}/\text{kg}$ )
	0~10	0.00	0~22	0.00
	10~16	20.81	22~42	10.95
	16~22	18.08	42~65	0.00
	22~65	0.00		

Notes:

<sup>(1)</sup>Values were obtained from geotechnical analyses at similar CAFB sites.

$\mu\text{g}/\text{kg}$  = milligrams per kilogram.

### **6.3 VLEACH SCREENING RESULTS**

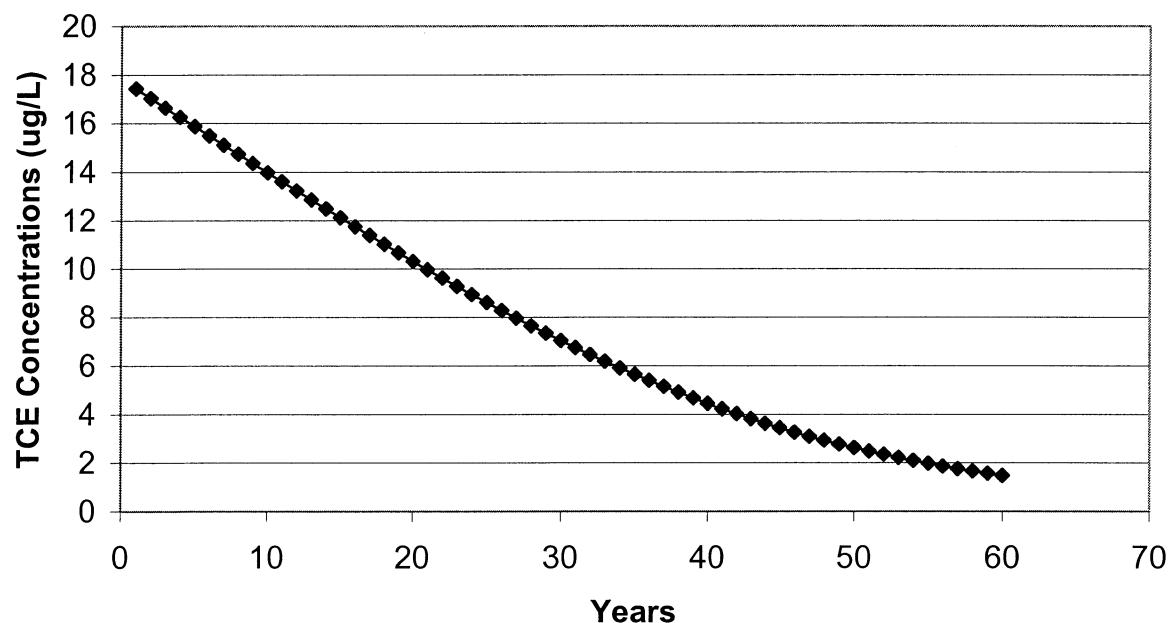
VLEACH screening results for TCE are summarized in Table 6-2 and presented graphically on Figure 6-1. The VLEACH simulation results indicate that leachate concentrations resulting from residual TCE at DA-4 will exceed the MCL of 5 µg/L.

Table 6-2: VLEACH Screening Results, TCE

Release Interval (year)	Leachate Concentration (µg/L)
1	17
5	16
10	14
15	12
20	10
25	9
30	7
40	4

Note: µg/L = microgram per liter

Figure 6-1 TCE Leachate Concentrations Computed by VLEACH



## **7.0 GROUNDWATER MODELING**

Since VLEACH screening results indicate that leachate concentrations resulting from the residual TCE at DA-4 will exceed the MCL, groundwater flow and transport modeling was performed to further assess potential impact to groundwater quality and partially fulfill the elements of STOP decision criterion III described in Section 1.4. The groundwater modeling was performed by Jacobs using Groundwater Vistas (ESI, 2001) and MODFLOW-SURFACT (HGL, 1996). The model results and documentation are provided in Appendix F. The annual mass flux rates of TCE to groundwater computed by VLEACH were used as input for the groundwater simulations. Influx of leachate containing TCE was simulated using injection wells corresponding to the vapor wells. Injection well inflow was computed based upon the infiltration rate and polygonal areas used in the VLEACH simulations. The groundwater simulations included the effects of advection, dispersion, and retardation. No decay was simulated.

The results of the groundwater simulations indicate that the leachate will have minimal impact on TCE concentrations in groundwater, and will not result in TCE concentrations in groundwater in excess of the MCL. Current maximum TCE groundwater concentrations indicated by the model are 0.59 µg/L at VW01 and VW-02, 0.26 µg/L at VMW-04, and 0.37 µg/L at VW04. The leaching condition does not result in an increase in maximum concentrations (Appendix F).

## 8.0 CONCLUSIONS

SVE and supplemental excavation were identified in the *SCOU ROD Part 2* as the selected remedy for TCE and cis-1,2-DCE in soil and soil gas at DA-4. SVE was initially implemented as a Removal Action at DA-4 followed by excavation and offsite disposal of the subsurface vault and associated contaminated soil, and additional SVE. Concentrations of VOCs in soil gas prior to the excavation were reduced substantially as a result of the source removal; average TCE concentrations in the source area were reduced by greater than 90 percent after the post-excavation SVE. Although TCE was detected in soil gas above VLEACH2 thresholds at the completion of SVE, the results of groundwater modeling conducted pursuant to the STOP process indicate that residual TCE will not degrade groundwater in excess of the MCL.

The *SCOU HHRA* concluded that DA-4 does not pose an adverse risk to human health, and indoor air modeling results using the J&E model suggest that residual VOC concentrations at DA-4 do not represent an adverse threat to human health via the indoor inhalation exposure pathway. The STOP evaluation indicates that the selected remedy has reduced concentrations of TCE and cis-1,2-DCE to levels that are protective of groundwater quality. Therefore, RAOs as specified in the *SCOU ROD Part 2* and Section 1.4 of this report have been attained, and accordingly, no contaminants are present at DA-4 that present an adverse risk to human health or groundwater quality. DA-4 is therefore recommended for closure and no further action.

## 9.0 REFERENCES

- California Environmental Protection Agency (Cal-EPA), 2003. *Screening-Level Model for Soil Gas Contamination, Version 2.0, Mod 3, November 1, 2003*. Adapted from the U.S. EPA Johnson and Ettinger Model by the Cal-EPA Human and Ecological Risk Division (HERD).
- California Environmental Protection Agency (Cal-EPA), Department of Toxic Substances Control, 2004. *Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*.
- Earth Tech. 2003a. *Source Control Operable Unit, Record of Decision Part 2, Castle Airport, California*. Prepared for Air Force Center for Environmental Excellence.
- Earth Tech. 2003b. *Soil Vapor Extraction Decision Study, Discharge Area 4, Data Report, Castle Airport, California*. Prepared for Air Force Center for Environmental Excellence.
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- Environmental Simulations, Inc. (ESI). 2001. *Groundwater Vistas™*. Version 3.15.
- HydroGeologic, Inc. (HGL). 1996. *MODFLOW-SURFACT*. Version 1.0.
- Jacobs Engineering Group (JEG). 1996. *Castle Air Force Base, DA-4 Design Letter Report*. Prepared for Air Force Center for Environmental Excellence.
- Jacobs Engineering Group (JEG). 1997a. *Remedial Investigation/Feasibility Study, Source Control Operable Unit*, Castle Airport, California.
- Jacobs Engineering Group (JEG). 1997b. *Remedial Investigation/Feasibility Study, Source Control Operable Unit, Part 2, Human Health Risk Assessment*, Castle Airport, California.
- Jacobs Engineering Group (JEG). 1998. *DA-4 Closure Report*. Prepared for Air Force Center for Environmental Excellence.
- Ravi, V. and Johnson, J. 1997. *A One-Dimensional Finite Difference Vadose Zone Leaching Model*. Developed for U.S. EPA Center for Subsurface Modeling Support.
- U.S. Air Force (USAF). 1995. *Action Memorandum, Removal Action at DA-4, Castle Air Force Base*.
- U.S. Air Force, Air Force Center for Environmental Excellence. 1996. *Technical Services Quality Assurance Program*.
- U.S. Environmental Protection Agency (U.S. EPA). 2000. *Users Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings*, Office of Emergency and Remedial Response, Washington, D.C. December.

**APPENDIX A**  
**LABORATORY REPORTS**

**SOIL CONFIRMATION SAMPLES**

# CASTLE ANALYTICAL LABORATORY

Environmental Testing Services  
Certificate #2480

2333 Shuttle Drive, Atwater, CA 95301

Phone: (209) 384-2930  
Fax: (209) 384-1507

Earth Tech Engineering & Environmental Services 300 Oceangate, Suite 700 Long Beach, CA 90802-4443 Attn: Jeff Stanek	Client Project ID: 79887 Castle AFB DA-4 Reference Number: 7472 Sample Description: Soil Sample Prep/Analysis Method: EPA 5030/8260 Lab Numbers: 7472-1S Client Sample ID: Stockpile 1	Sampled: 10-21-04 Received: 10-21-04 Extracted: 10-21-04 Analyzed: 10-21-04 Reported: 10-21-04
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## VOLATILE ORGANICS - EPA METHOD 8260 GC/MS

ANALYTE	REPORTING LIMIT (mg/Kg)	SAMPLE RESULT (mg/Kg)	ANALYTE	REPORTING LIMIT (mg/Kg)	SAMPLE RESULT (mg/Kg)
Benzene	0.010	ND	1,1-Dichloropropene	0.010	ND
Bromobenzene	0.010	ND	cis-1,3-Dichloropropene	0.010	ND
Bromoform	0.010	ND	trans-1,3-Dichloropropene	0.010	ND
Bromomethane	0.010	ND	Ethylbenzene	0.010	ND
n-Butylbenzene	0.010	ND	Hexachlorobutadiene	0.010	ND
sec-Butylbenzene	0.010	ND	Isopropylbenzene	0.010	ND
tert-Butylbenzene	0.010	ND	p-Isopropyltoluene	0.010	ND
Carbon tetrachloride	0.010	ND	Methylene chloride	0.040	ND
Chlorobenzene	0.010	ND	Naphthalene	0.040	ND
Chlorodibromomethane	0.010	ND	n-Propylbenzene	0.010	ND
Chloroethane	0.010	ND	Styrene	0.010	ND
Chloroform	0.010	ND	1,1,1,2-Tetrachloroethane	0.010	ND
Chloromethane	0.010	ND	1,1,2,2-Tetrachloroethane	0.010	ND
2-Chlorotoluene	0.010	ND	Tetrachloroethene	0.010	ND
4-Chlorotoluene	0.010	ND	Toluene	0.010	ND
1,2-Dibromo-3-chloropropane	0.040	ND	1,2,3-Trichlorobenzene	0.010	ND
1,2-Dibromoethane (EDB)	0.010	ND	1,2,4-Trichlorobenzene	0.010	ND
Dibromomethane	0.010	ND	1,1,1-Trichloroethane	0.010	ND
1,2-Dichlorobenzene	0.010	ND	1,1,2-Trichloroethane	0.010	ND
1,3-Dichlorobenzene	0.010	ND	Trichloroethene	0.010	0.052
1,4-Dichlorobenzene	0.010	ND	Trichlorofluoromethane	0.010	ND
Dichlorodifluoromethane	0.010	ND	1,2,3-Trichloropropane	0.010	ND
1,1-Dichloroethane	0.010	ND	1,2,4-Trimethylbenzene	0.010	ND
1,2-Dichloroethane	0.010	ND	1,3,5-Trimethylbenzene	0.010	ND
1,1-Dichloroethene	0.010	ND	Vinyl Chloride	0.010	ND
cis-1,2-Dichloroethene	0.010	ND	Xylenes, total	0.010	ND
trans-1,2-Dichloroethene	0.010	ND	Oxygenates		
1,2-Dichloropropane	0.010	ND	tert-Butyl Alcohol (tBA)	0.80	ND
1,3-Dichloropropane	0.010	ND	Methyl tert-Butyl Ether (MTBE)	0.010	ND
2,2-Dichloropropane	0.010	ND	Di-Isopropyl Ether (DIPE)	0.010	ND

Surrogate Recoveries			
Dibromofluoromethane	103%	Toluene-d8	103%
1,2-Dichloroethane-d4	94.4%	p-Bromofluorobenzene	85.3%

Instrument ID: HP 5972MS

Analytes reported as ND were not detected or below the Practical Quantitation Limit.

Practical Quantitation Limit = Reporting Limit x Report Limit Multiplication Factor

( $\mu\text{g/L}$ ) = micrograms per liter, or parts per billion (ppb)

APPROVED BY:

  
Clari J. Cone  
Laboratory Manager

APPROVED BY:

  
James C. Phillips  
Laboratory Director

# CASTLE ANALYTICAL LABORATORY

Environmental Testing Services  
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2333 Shuttle Drive, Atwater, CA 95301

Phone: (209) 384-2930  
Fax: (209) 384-1507

Earth Tech Engineering & Environmental Services 300 Oceangate, Suite 700 Long Beach, CA 90802-4443 Attn: Jeff Stanek	Client Project ID: 79887 Castle AFB DA-4 Reference Number: 7472 Sample Description: Soil Sample Prep/Analysis Method: EPA 5030/8260 Lab Numbers: 7472-2S Client Sample ID: Stockpile 2	Sampled: 10-21-04 Received: 10-21-04 Extracted: 10-21-04 Analyzed: 10-21-04 Reported: 10-21-04
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## VOLATILE ORGANICS - EPA METHOD 8260 GC/MS

ANALYTE	REPORTING LIMIT (mg/Kg)	SAMPLE RESULT (mg/Kg)	ANALYTE	REPORTING LIMIT (mg/Kg)	SAMPLE RESULT (mg/Kg)
Benzene	0.010	ND	1,1-Dichloropropene	0.010	ND
Bromobenzene	0.010	ND	cis-1,3-Dichloropropene	0.010	ND
Bromoform	0.010	ND	trans-1,3-Dichloropropene	0.010	ND
Bromomethane	0.010	ND	Ethylbenzene	0.010	ND
n-Butylbenzene	0.010	ND	Hexachlorobutadiene	0.010	ND
sec-Butylbenzene	0.010	ND	Isopropylbenzene	0.010	ND
tert-Butylbenzene	0.010	ND	p-Isopropyltoluene	0.010	ND
Carbon tetrachloride	0.010	ND	Methylene chloride	0.040	ND
Chlorobenzene	0.010	ND	Naphthalene	0.040	ND
Chlorodibromomethane	0.010	ND	n-Propylbenzene	0.010	ND
Chloroethane	0.010	ND	Styrene	0.010	ND
Chloroform	0.010	ND	1,1,1,2-Tetrachloroethane	0.010	ND
Chloromethane	0.010	ND	1,1,2,2-Tetrachloroethane	0.010	ND
2-Chlorotoluene	0.010	ND	Tetrachloroethene	0.010	ND
4-Chlorotoluene	0.010	ND	Toluene	0.010	ND
1,2-Dibromo-3-chloropropane	0.040	ND	1,2,3-Trichlorobenzene	0.010	ND
1,2-Dibromoethane (EDB)	0.010	ND	1,2,4-Trichlorobenzene	0.010	ND
Dibromomethane	0.010	ND	1,1,1-Trichloroethane	0.010	ND
1,2-Dichlorobenzene	0.010	ND	1,1,2-Trichloroethane	0.010	ND
1,3-Dichlorobenzene	0.010	ND	Trichloroethene	0.010	6.0
1,4-Dichlorobenzene	0.010	ND	Trichlorofluoromethane	0.010	ND
Dichlorodifluoromethane	0.010	ND	1,2,3-Trichloropropane	0.010	ND
1,1-Dichloroethane	0.010	ND	1,2,4-Trimethylbenzene	0.010	0.012
1,2-Dichloroethane	0.010	ND	1,3,5-Trimethylbenzene	0.010	ND
1,1-Dichloroethene	0.010	ND	Vinyl Chloride	0.010	ND
cis-1,2-Dichloroethene	0.010	0.091	Xylenes, total	0.010	ND
trans-1,2-Dichloroethene	0.010	ND	Oxygenates		
1,2-Dichloropropane	0.010	ND	tert-Butyl Alcohol (tBA)	0.80	ND
1,3-Dichloropropane	0.010	ND	Methyl tert-Butyl Ether (MTBE)	0.010	ND
2,2-Dichloropropane	0.010	ND	Di-Isopropyl Ether (DIPE)	0.010	ND

\* Report limit multiplication factor for Trichloroethene (TCE): 10

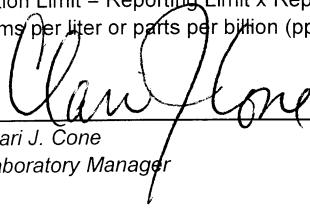
Surrogate Recoveries			
Dibromofluoromethane	93.3%	Toluene-d8	96.8%
1,2-Dichloroethane-d4	97.0%	p-Bromofluorobenzene	82.0%

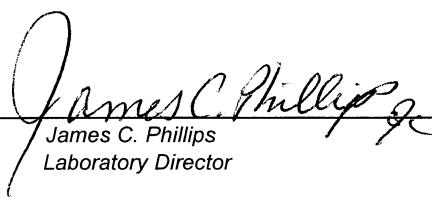
Instrument ID: HP 5972MS

Analytes reported as ND were not detected or below the Practical Quantitation Limit.

Practical Quantitation Limit = Reporting Limit x Report Limit Multiplication Factor

( $\mu\text{g/L}$ ) = micrograms per liter or parts per billion (ppb)

APPROVED BY:   
Clari J. Cone  
Laboratory Manager

APPROVED BY:   
James C. Phillips  
Laboratory Director

# CASTLE ANALYTICAL LABORATORY

Environmental Testing Services  
Certificate #2480

2333 Shuttle Drive, Atwater, CA 95301

Phone: (209) 384-2930  
Fax: (209) 384-1507

Earth Tech Engineering & Environmental Services 300 Oceangate, Suite 700 Long Beach, CA 90802-4443 Attn: Jeff Stanek	Client Project ID: 79887 Castle AFB DA-4 Reference Number: 7472 Sample Description: Soil Analyst: Scott Foster	Method: EPA 5030/8260 Instrument ID: HP 5972 MS Prepared: 10-21-04 Analyzed: 10-21-04 Reported: 10-21-04
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## QUALITY CONTROL DATA REPORT

SPIKE ID: VSMS-O214

	Reporting Limit mg/Kg	BLANK Result mg/Kg	Spiking Level mg/Kg	Control Spike %R	%R Limits
<b>COMPOUNDS</b>					
t-Butyl Alcohol (t-BA)	0.80	ND	3.00	95.3%	55.3 - 153
Methyl t-butyl ether (MTBE)	0.010	ND	0.100	107%	60.4 - 137
Diisopropyl ether (DIPE)	0.010	ND	0.100	115%	70.0 - 130
Ethyl t-Butyl ether (ETBE)	0.010	ND	0.100	92.0%	70.0 - 130
t-Amyl methyl ether (TAME)	0.010	ND	0.100	86.8%	70.0 - 130
1,2-Dichloroethane (1,2-DCA)	0.010	ND	0.100	124%	63.6 - 138
Ethylene dibromide (EDB)	0.010	ND	0.100	122%	66.7 - 129
1,1-Dichloroethene (1,1,DCE)	0.010	ND	0.100	109%	54.5 - 154
Benzene	0.010	ND	0.100	119%	70.0 - 130
Trichloroethene (TCE)	0.010	ND	0.100	122%	70.0 - 130
Toluene	0.010	ND	0.100	120%	70.0 - 130
Chlorobenzene	0.010	ND	0.100	120%	70.0 - 130
Surrogate:					
Dibromofluoromethane	0.010	113%	0.400	130%	66.7 - 132
1,2-Dichloroethane-d4	0.010	117%	0.400	132%	59.2 - 135
Toluene-d8	0.010	117%	0.400	130%	62.9 - 132
4-Bromofluorobenzene	0.010	91.5%	0.400	109%	69.7 - 131

	Spiking Level mg/Kg	MATRIX SPIKE %R	MATRIX SPIKE DUP %R	%R Limits	%RPD
<b>COMPOUNDS</b>					
t-Butyl Alcohol (t-BA)	3.00	71.6%	72.6%	55.3 - 153	1.32%
Methyl t-butyl ether (MTBE)	0.100	79.6%	81.6%	60.4 - 137	2.48%
Diisopropyl ether (DIPE)	0.100	80.4%	79.6%	70.0 - 130	0.990%
Ethyl t-Butyl ether (ETBE)	0.100	75.6%	76.4%	70.0 - 130	1.05%
t-Amyl methyl ether (TAME)	0.100	72.4%	76.0%	70.0 - 130	4.40%
1,2-Dichloroethane (1,2-DCA)	0.100	86.0%	87.6%	63.6 - 138	1.81%
Ethylene dibromide (EDB)	0.100	82.0%	86.0%	66.7 - 129	4.63%
1,1-Dichloroethene (1,1,DCE)	0.100	74.8%	78.0%	54.5 - 154	4.19%
Benzene	0.100	83.6%	86.4%	70.0 - 130	3.25%
Trichloroethene (TCE)	0.100	80.8%	80.0%	70.0 - 130	0.602%
Toluene	0.100	81.2%	80.8%	70.0 - 130	0.477%
Chlorobenzene	0.100	82.8%	84.4%	70.0 - 130	1.89%
Surrogate:					
Dibromofluoromethane	0.400	99.8%	104%	66.7 - 132	4.31%
1,2-Dichloroethane-d4	0.400	96.5%	108%	59.2 - 135	10.8%
Toluene-d8	0.400	97.7%	99.2%	62.9 - 132	1.52%
4-Bromofluorobenzene	0.400	84.2%	83.4%	69.7 - 131	0.955%

The LCS (Laboratory Check Sample) is a control sample of known, interferent free matrix that is fortified with representative analytes and analyzed using the same reagents, preparation and analytical methods employed for the samples. The LCS % recovery is used for validation of sample batch results. Due to matrix effects, the QC limits and recoveries for MS/MSD's are advisory only and are not used to accept or reject batch results.

ANALYST:

Clari J. Cone

APPROVED BY:

James C. Phillips  
Laboratory Director



## Chain of Custody Record

Lab job no.: -  
Date 10  
Page 1

Laboratory	<u>CAS TLE AND L YTRIC AL</u>	Method of Shipment	<u>_____</u>
Address	<u>144 ARI VATION CA</u>	Shipment No.	<u>_____</u>
Client	<u>USAF</u>	Airbill No.	<u>_____</u>
Address	<u>_____</u>	Cooler No.	<u>_____</u>
Project Name	<u>CAS TLE AER DA-4</u>	Project Manager	<u>J. STANZEK</u>
Project Number	<u>793357</u>	Telephone No.	<u>(512) 451-7200</u>
		Fax. No.	<u>(512) 751-2486</u>
		Samplers: <u>(Signature) Jim H</u>	

**FINAL VAPOR SAMPLES**

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STL

STL Los Angeles  
1721 South Grand Avenue  
Santa Ana, CA 92705

Tel: 714 258 8610 Fax: 714 258 0921  
[www.stl-inc.com](http://www.stl-inc.com)

June 27, 2005

STL LOT NUMBER: **E5F140337**

PO/CONTRACT: 79887-05

Jeff Stanek  
EARTH TECH, INC.  
100 West Broadway, Suite 240  
P. O. Box 22785  
Long Beach, CA 90802

Dear Jeff Stanek,

This report contains the analytical results for the seven samples received under chain of custody by STL Los Angeles on June 10, 2005. These samples are associated with your CASTLE AIRPORT-EARTH TECH project. Preliminary data was provided on June 23, 2005.

STL Los Angeles certifies that the test results provided in this report meet all the requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in the case narrative. The case narrative is an integral part of the report. NELAP Certification Number for STL Los Angeles is 01118CA/E87652.

This report shall not be reproduced except in full, without the written approval of the laboratory.

This report contains 000039 pages.

000001

Severn Trent Laboratories, Inc.



## CASE NARRATIVE

Historical control limits for the LCS are used to define the estimate of uncertainty for a method.

All applicable quality control procedures met method-specified acceptance criteria.

Per instruction from Earth Tech personnel on June 16, 2005, the analysis for this project is method TO14A.

If you have any questions, please feel free to call me at 714.258.8610.

Sincerely,



Sabina Sudoko  
Project Manager  
CC: Project File

000002



**Chain of  
Custody Record**

**SEVERN  
TRENT**

**Severn Trent Laboratories, Inc.**

STL-4124 (0901)

Client **Earth Tech**

Address **21064 Bake Parkway, Ste 200**

City **Lake Forest**

State **CA**

Zip Code **92630**

Project Name and Location (State)

**Castl Airport**

Contract/Purchase Order/Quote No.

Project Manager **Jeff Stank**

Telephone Number (Area Code)/Fax Number **562-637-7804**

Site Contact **7929 4170 2496**

Carrier/Waybill Number **70-15?**

Lab Contact **70-15?**

Analysis (Attach list if more space is needed)

Special Instructions/  
Conditions of Receipt

Sample I.D. No. and Description  
(Containers for each sample may be combined on one line)

Date **6-8-05**

Time **11:19**

Air **✓**

Water **✓**

Soil **✓**

Seal **✓**

Aqueous **✓**

Unpres. **✓**

H2SO4 **✓**

NaOH **✓**

ZnA/C **✓**

HCl **✓**

HNO3 **✓**

Matrix **✓**

Containers &  
Preservatives

Sample Disposal

QC Requirements (Specify)

Return To Client **□**

Disposal By Lab **□**

Archive For **\_\_\_\_\_**

Months **longer than / month**

Possible Hazard Identification

Non-Hazard **□**

Flammable **□**

Skin Irritant **□**

Poison B **□**

Poison A **□**

Other **\_\_\_\_\_**

Turn Around Time Required

24 Hours **□**

48 Hours **□**

7 Days **□**

14 Days **□**

21 Days **□**

Other **\_\_\_\_\_**

1. Received By

**Lloyd Stewart**

Date **6-8-05**

Time **16:05**

1. Received By

**FED Ex**

Date **6/10/05**

Time **0930**

2. Received By

**J**

Date **6/10/05**

Time **0930**

3. Received By

**J**

Date **6-8-05**

Time **16:05**

Comments **Call Jeff Stank for analysis method**

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Filed Copy

**000003**

## Sudoku, Sabina

---

**From:** Stanek, Jeffrey M. [Jeffrey.Stanek@earthtech.com]  
**Sent:** Thursday, June 16, 2005 9:12 AM  
**To:** Sudoku, Sabina  
**Subject:** RE: E5F140337 CASTLE AIR

Sabina:

The information on the sample confirmation sheet is correct. In summary, the Castle AFB vapor samples will be analyzed for TO-14 and results will be reported in ug/L. Please let me know if you have any questions.

Regards,

Jeff Stanek  
Project Manager  
Earth Tech, Inc.  
(562) 951-2062

-----Original Message-----

**From:** Sudoku, Sabina [mailto:[ssudoko@stl-inc.com](mailto:ssudoko@stl-inc.com)]  
**Sent:** Wednesday, June 15, 2005 12:21 PM  
**To:** Jeff Stanek  
**Subject:** E5F140337 CASTLE AIR

Jeff,

Samples received for CASTLE AFB Air project.

Please check the sample confirmation sheet. As per our conversation, the samples have been logged in for TO14 (ug/L).

<<E5F140337.pdf>>

Thank you..

**Sabina R. Sudoku**  
Project Manager, Sr.  
STL Los Angeles  
ph: 714.258.8610 ext.306

email: [ssudoko@stl-inc.com](mailto:ssudoko@stl-inc.com)

Confidentiality Notice: The information contained in this message is intended only for the use of the addressee, and may be confidential and/or privileged. If the reader of this message is not the intended recipient, or the employee or agent responsible to deliver it to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify the

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STL

CANISTER FIELD DATA RECORD

CLIENT: ET- PRAXIS  
CANISTER SERIAL #: 03303  
DATE CLEANED: 6-2-05 B  
CLIENT SAMPLE #: \_\_\_\_\_  
SITE LOCATION: \_\_\_\_\_

VFR ID: \_\_\_\_\_

Duration of comp.: \_\_\_\_\_ hrs. / mins.

Flow setting: \_\_\_\_\_ ml/min

Initials: \_\_\_\_\_

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30	6/6/05	K
INITIAL FIELD VACUUM				
FINAL FIELD READING				

LABORATORY CANISTER PRESSURIZATION

INITIAL VACUUM (PSIA)	14.71	6-15-05	a
FINAL PRESSURE (PSIA)	23.81	6-15-05	a

Pressurization Gas: N2

COMMENTS:

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

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CANISTER FIELD DATA RECORD

CLIENT: ET- PRAXIS  
CANISTER SERIAL #: A-324  
DATE CLEANED: 6-205 B  
CLIENT SAMPLE #: \_\_\_\_\_  
SITE LOCATION: \_\_\_\_\_

VFR ID: \_\_\_\_\_

Duration of comp.: \_\_\_\_\_ hrs. / mins.

Flow setting: \_\_\_\_\_ ml/min

Initials: \_\_\_\_\_

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30"	6/6/05	K
INITIAL FIELD VACUUM				
FINAL FIELD READING				

LABORATORY CANISTER PRESSURIZATION

INITIAL VACUUM (PSIA)	1157	6-15-05	a
FINAL PRESSURE (PSIA)	24.07	6-15-05	a

Pressurization Gas: N<sub>2</sub>

COMMENTS:

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

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STL

CANISTER FIELD DATA RECORD

CLIENT: ET- PRAXIS  
CANISTER SERIAL #: 61  
DATE CLEANED: 6-2-05 B  
CLIENT SAMPLE #: \_\_\_\_\_  
SITE LOCATION: \_\_\_\_\_

VFR ID: \_\_\_\_\_

Duration of comp.: \_\_\_\_\_ hrs. / mins.

Flow setting: \_\_\_\_\_ ml/min

Initials: \_\_\_\_\_

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30 "	6/6/05	(K)
INITIAL FIELD VACUUM				
FINAL FIELD READING				

LABORATORY CANISTER PRESSURIZATION

INITIAL VACUUM (PSIA)	11.75	6-15-05	~
FINAL PRESSURE (PSIA)	23.94	6-15-05	~

Pressurization Gas: N<sub>2</sub>

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

SEVERN  
TRENT

4  
STL

### CANISTER FIELD DATA RECORD

CLIENT: ET- PRAXIS  
CANISTER SERIAL #: 0168  
DATE CLEANED: 6-2-05 B  
CLIENT SAMPLE #: \_\_\_\_\_  
SITE LOCATION: \_\_\_\_\_

VFR ID: \_\_\_\_\_

Duration of comp. : \_\_\_\_\_ hrs. / mins.

Flow setting: \_\_\_\_\_ ml/min

Initials: \_\_\_\_\_

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30	6/6/05	K
INITIAL FIELD VACUUM				
FINAL FIELD READING				

### LABORATORY CANISTER PRESSURIZATION

INITIAL VACUUM (PSIA)	11.71	6-15-05	n
FINAL PRESSURE (PSIA)	24.02	6-15-05	w

Pressurization Gas: N

COMMENTS:

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

SEVERN  
TRENT

STL

CANISTER FIELD DATA RECORD

CLIENT: ET- PRAXIS  
CANISTER SERIAL #: 93263  
DATE CLEANED: 6-2-05 B  
CLIENT SAMPLE #: \_\_\_\_\_  
SITE LOCATION: \_\_\_\_\_

VFR ID: \_\_\_\_\_

Duration of comp.: \_\_\_\_\_ hrs. / mins.

Flow setting: \_\_\_\_\_ ml/min

Initials: \_\_\_\_\_

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30 "	6/6/05	(K)
INITIAL FIELD VACUUM				
FINAL FIELD READING				

LABORATORY CANISTER PRESSURIZATION

INITIAL VACUUM (PSIA)	11.78	6-15-05	u
FINAL PRESSURE (PSIA)	24.00	6-15-05	u

Pressurization Gas: N<sub>2</sub>

COMMENTS:

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

SEVERN  
TRENT

STL

CANISTER FIELD DATA RECORD

CLIENT: ET- PRAXIS  
CANISTER SERIAL #: 04163  
DATE CLEANED: 6-205 B  
CLIENT SAMPLE #: \_\_\_\_\_  
SITE LOCATION: \_\_\_\_\_

VFR ID: \_\_\_\_\_

Duration of comp. : \_\_\_\_\_ hrs. / mins.

Flow setting: \_\_\_\_\_ ml/min

Initials: \_\_\_\_\_

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30 "	6/6/05	(K)
INITIAL FIELD VACUUM				
FINAL FIELD READING				

LABORATORY CANISTER PRESSURIZATION

INITIAL VACUUM (PSIA)	14.39	6-15-05	~
FINAL PRESSURE (PSIA)	23.71	6-15-05	~

Pressurization Gas: N

COMMENTS:

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

7/16  
SEVERN  
TRENT

STL

### CANISTER FIELD DATA RECORD

CLIENT: ET- PRAXIS  
CANISTER SERIAL #: 9633B  
DATE CLEANED: 6-2-05 B  
CLIENT SAMPLE #: \_\_\_\_\_  
SITE LOCATION: \_\_\_\_\_

VFR ID: \_\_\_\_\_

Duration of comp.: \_\_\_\_\_ hrs. / mins.

Flow setting: \_\_\_\_\_ ml/min

Initials: \_\_\_\_\_

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30"	6/6/05	K
INITIAL FIELD VACUUM				
FINAL FIELD READING				

### LABORATORY CANISTER PRESSURIZATION

INITIAL VACUUM (PSIA)	11.70	6.1505	68
FINAL PRESSURE (PSIA)	24.26	6.1505	68

Pressurization Gas: N<sub>2</sub>

COMMENTS:

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

CANISTER QC  
CERTIFICATION

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Certification Type: T0 - 15 ML

Date Cleaned/Batch 6-0205 B

Date of QC 06-03-05

Data File Number MB06032 (MSE)

Canister ID Numbers

<u>* 12464</u>	<u>04163 ✓</u>
<u>9424B3</u>	<u>04720</u>
<u>93263 ✓</u>	<u>61 ✓</u>
<u>A-222</u>	<u>03303 ✓</u>
<u>A-324 ✓</u>	<u>0168 ✓</u>
<u>124</u>	<u>9633B ✓</u>

The above canisters were cleaned as a batch. This certifies this batch contains no target analyte concentration greater than or equal to the method criteria for the "Certification Type" indicated above.

\* INDICATES THE CAN OR CANS WHICH WERE SCREENED.

J. K.  
Reviewed By:

6-3-05  
Date:  
N:COINDOCS\Can QC Cert (012103).doc

STL - Los Angeles

AIR LOW LEVEL TO-14A / TO-15  
Data file : \\LAPC062\MSE\_D\chem\gcmse.i\050603.b\MB06032.D  
Lab Smp Id: BLANK Client Smp ID: 12464  
Inj Date : 03-JUN-2005 11:41  
Operator : DLK Inst ID: gcmse.i  
Smp Info : BLANK,12464,,METHOD BLANK,  
Misc Info : 1,1,250,250,3,,BLANK,TO15LONG.SUB,1,  
Comment :  
Method : \\LAPC062\MSE\_D\chem\gcmse.i\050603.b\TO15.m  
Meth Date : 03-Jun-2005 12:09 kammererd Quant Type: ISTD  
Cal Date : 02-JUN-2005 11:08 Cal File: IC06028.D  
Als bottle: 8 QC Sample: BLANK  
Dil Factor: 1.00000  
Integrator: HP RTE Compound Sublist: TO15LONG.SUB  
Target Version: 4.12  
Processing Host: LAPC062

Concentration Formula:

Amt \* DF \* (FinalPres / InitPres)\*(CalVol / SmpVol) \* CpndVariable

Name	Value	Description
DF	1.000	Dilution Factor
FinalPres	1.000	Final Pressure
InitPres	1.000	Initial Pressure
CalVol	250.000	Calibration Volume
SmpVol	250.000	Sample Volume
Cpnd Variable		Local Compound Variable

Compounds	QUANT SIG	MASS	CONCENTRATIONS				
			RT	EXP RT	REL RT	RESPONSE	( ppbv)
* 48 Bromochloromethane	49	11.802	11.808	(1.000)	77344	4.00000	
\$ 54 1,2-Dichloroethane-d4	65	12.592	12.598	(0.956)	77672	3.87058	3.870
* 60 1,4-Difluorobenzene	114	13.177	13.183	(1.000)	230336	4.00000	
\$ 71 Toluene-d8	98	15.318	15.318	(0.889)	213324	4.01003	4.010
* 81 Chlorobenzene-d5	117	17.234	17.234	(1.000)	203154	4.00000	
\$ 92 4-Bromofluorobenzene	95	18.559	18.559	(1.077)	138415	3.96313	3.963

Data File: \\LAPC062\HSE\_D\chem\gomsse.i\050603.b\HB06032.D

Date : 03-JUN-2005 11:41

Client ID: 12464

Sample Info: BLANK,12464.,METHOD BLANK,

Page 6

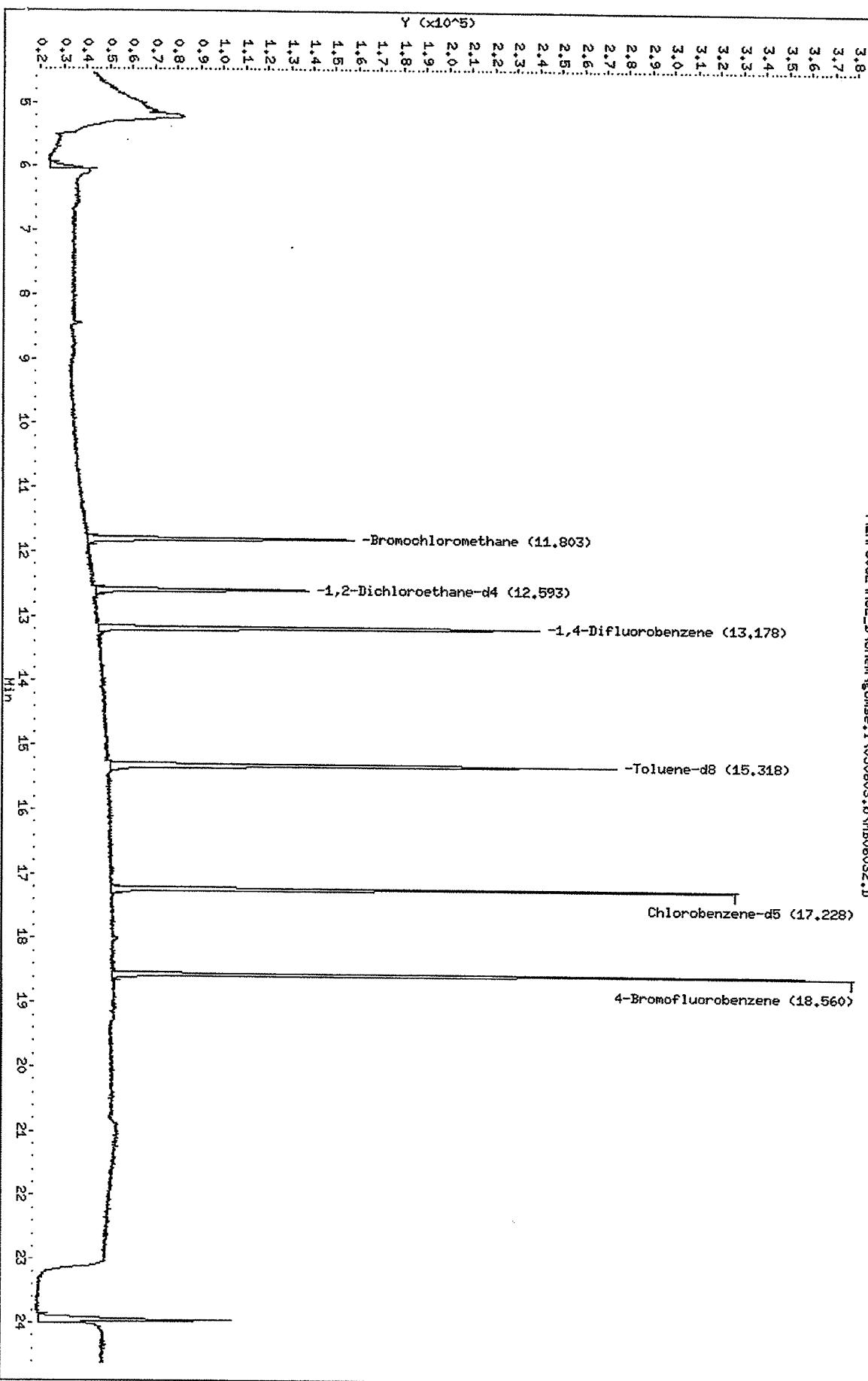
Instrument: gomsse.i

Operator: DLUK

Column diameter: 0.32

\\LAPC062\HSE\_D\chem\gomsse.i\050603.b\HB06032.D

Column phase: J&W DB-5ms





# Analytical Report

## **ANALYTICAL REPORT**

**PROJECT NO. 79887-05**

**CASTLE AIRPORT-EARTH TECH**

**Lot #: E5F140337**

**Jeff Stanek**

**EARTH TECH, INC.**

**SEVERN TRENT LABORATORIES, INC.**

**Sabina Sudoko  
Project Manager**

**June 23, 2005**

## EXECUTIVE SUMMARY - Detection Highlights

E5F140337

<u>PARAMETER</u>	<u>RESULT</u>	<u>REPORTING LIMIT</u>	<u>UNITS</u>	<u>ANALYTICAL METHOD</u>
<b>CASTL-DA4-VW05-99 06/08/05 11:19 001</b>				
cis-1,2-Dichloroethene	0.021	0.0079	ug/L	EPA-19 TO-14A
Trichloroethene	0.84	0.011	ug/L	EPA-19 TO-14A
Total Non-Methane Hydrocarbons	160	1.8	ug/L	EPA-19 TO-14A
<b>CASTL-DA4-VW03-99 06/08/05 11:21 002</b>				
cis-1,2-Dichloroethene	0.032	0.027	ug/L	EPA-19 TO-14A
Trichloroethene	5.8	0.038	ug/L	EPA-19 TO-14A
Total Non-Methane Hydrocarbons	1100	6.2	ug/L	EPA-19 TO-14A
<b>CASTL-DA4-VW01-99 06/08/05 11:40 003</b>				
Trichloroethene	38	0.22	ug/L	EPA-19 TO-14A
Total Non-Methane Hydrocarbons	6500	36	ug/L	EPA-19 TO-14A
<b>CASTL-DA4-VW02-99 06/08/05 11:54 004</b>				
Trichloroethene	33	0.19	ug/L	EPA-19 TO-14A
Total Non-Methane Hydrocarbons	5400	31	ug/L	EPA-19 TO-14A
<b>CASTL-DA4-VW16-99 06/08/05 12:28 005</b>				
cis-1,2-Dichloroethene	0.049	0.013	ug/L	EPA-19 TO-14A
Chloroform	0.0070	0.016	ug/L	EPA-19 TO-14A
Trichloroethene	2.4	0.019	ug/L	EPA-19 TO-14A
Total Non-Methane Hydrocarbons	430	3.0	ug/L	EPA-19 TO-14A
<b>CASTL-DA4-VW04-98 06/08/05 13:15 006</b>				
Trichloroethene	20	0.095	ug/L	EPA-19 TO-14A
Total Non-Methane Hydrocarbons	3400	16	ug/L	EPA-19 TO-14A
<b>CASTL-DA4-VW04-99 06/08/05 13:15 007</b>				
Trichloroethene	20	0.095	ug/L	EPA-19 TO-14A
Total Non-Methane Hydrocarbons	3400	16	ug/L	EPA-19 TO-14A

## ANALYTICAL METHODS SUMMARY

E5F140337

PARAMETER	ANALYTICAL METHOD
Volatile Organics (TO-14A)	EPA-19 TO-14A

### References:

- EPA-19 "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", EPA/600/4-89/017, January 1988

## SAMPLE SUMMARY

E5F140337

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
HDLEF	001	CASTL-DA4-VW05-99	06/08/05	11:19
HDLEG	002	CASTL-DA4-VW03-99	06/08/05	11:21
HDLEH	003	CASTL-DA4-VW01-99	06/08/05	11:40
HDLEK	004	CASTL-DA4-VW02-99	06/08/05	11:54
HDLEL	005	CASTL-DA4-VW16-99	06/08/05	12:28
HDLEN	006	CASTL-DA4-VW04-98	06/08/05	13:15
HDLEP	007	CASTL-DA4-VW04-99	06/08/05	13:15

### NOTE (S) :

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filtered test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW05-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-001 Work Order #....: HDLEF1AC Matrix.....: AE  
Date Sampled...: 06/08/05 11:19 Date Received...: 06/10/05  
Prep Date.....: 06/21/05 Analysis Date...: 06/21/05  
Prep Batch #....: 5173212 Analysis Time...: 13:10  
Dilution Factor: 1  
Analyst ID.....: 101605 Instrument ID...: MSB  
Method.....: EPA-19 TO-14A

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	MDL
Dichlorodifluoromethane	ND	0.0099	ug/L	0.0025
Chloromethane	ND	0.0082	ug/L	0.0021
1,2-Dichloro-	ND	0.014	ug/L	0.0056
1,1,2,2-tetrafluoroethane	ND	0.0051	ug/L	0.0020
Vinyl chloride	ND	0.0078	ug/L	0.0039
Bromomethane	ND	0.011	ug/L	0.0021
Chloroethane	ND	0.011	ug/L	0.0028
Trichlorofluoromethane	ND	0.0079	ug/L	0.0020
1,1-Dichloroethene	ND	0.031	ug/L	0.0062
Carbon disulfide	ND	0.015	ug/L	0.0038
1,1,2-Trichloro-	ND	0.024	ug/L	0.0047
1,2,2-trifluoroethane	ND	0.0069	ug/L	0.0028
Acetone	ND	0.0079	ug/L	0.0020
Methylene chloride	ND	0.0081	ug/L	0.0020
trans-1,2-Dichloroethene	ND	0.0079	ug/L	0.0059
cis-1,2-Dichloroethene	0.021	0.0097	ug/L	0.0032
2-Butanone (MEK)	ND	0.011	ug/L	0.0039
Chloroform	ND	0.013	ug/L	0.0027
1,1,1-Trichloroethane	ND	0.0064	ug/L	0.0031
Carbon tetrachloride	ND	0.0081	ug/L	0.0026
Benzene	ND	0.0092	ug/L	0.0037
1,2-Dichloroethane	ND	0.013	ug/L	0.0053
Trichloroethene	0.84	0.011	ug/L	0.0027
cis-1,3-Dichloropropene	ND	0.0091	ug/L	0.0023
4-Methyl-2-pentanone (MIBK)	ND	0.041	ug/L	0.0082
Toluene	ND	0.0075	ug/L	0.0019
trans-1,3-Dichloropropene	ND	0.0091	ug/L	0.0036
1,1,2-Trichloroethane	ND	0.011	ug/L	0.0033
Tetrachloroethene	ND	0.014	ug/L	0.0041
2-Hexanone	ND	0.041	ug/L	0.0041
Dibromochloromethane	ND	0.017	ug/L	0.0042
1,2-Dibromoethane (EDB)	ND	0.015	ug/L	0.0038

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Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW05-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-001 Work Order #....: HDLEF1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Chlorobenzene	ND	0.0092	ug/L	0.0023
Ethylbenzene	ND	0.0087	ug/L	0.0022
m-Xylene & p-Xylene	ND	0.0087	ug/L	0.0043
o-Xylene	ND	0.0087	ug/L	0.0026
Styrene	ND	0.0085	ug/L	0.0025
Bromoform	ND	0.0078	ug/L	0.0039
1,1,2,2-Tetrachloroethane	ND	0.014	ug/L	0.0034
Benzyl chloride	ND	0.052	ug/L	0.0041
4-Ethyltoluene	ND	0.0098	ug/L	0.0034
1,3,5-Trimethylbenzene	ND	0.0098	ug/L	0.0054
1,2,4-Trimethylbenzene	ND	0.0098	ug/L	0.0063
1,3-Dichlorobenzene	ND	0.012	ug/L	0.0044
1,4-Dichlorobenzene	ND	0.012	ug/L	0.0048
1,2-Dichlorobenzene	ND	0.012	ug/L	0.0053
1,2,4-Trichloro- benzene	ND	0.037	ug/L	0.0097
Hexachlorobutadiene	ND	0.043	ug/L	0.013
n-Hexane	ND	0.0070	ug/L	0.0021
Total Non-Methane Hydrocarbons as Hexane	160	1.8	ug/L	0.36

Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW03-99

GC/MS Volatiles

Lot-Sample #....:	E5F140337-002	Work Order #....:	HDLEG1AC	Matrix.....:	AE
Date Sampled....:	06/08/05 11:21	Date Received...:	06/10/05		
Prep Date.....:	06/21/05	Analysis Date...:	06/21/05		
Prep Batch #....:	5173212	Analysis Time...:	13:44		
Dilution Factor:	3.46				
Analyst ID.....:	101605	Instrument ID...:	MSB		
		Method.....:	EPA-19 TO-14A		

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	MDL
Dichlorodifluoromethane	ND	0.034	ug/L	0.0086
Chloromethane	ND	0.028	ug/L	0.0073
1,2-Dichloro-	ND	0.048	ug/L	0.019
1,1,2,2-tetrafluoroethane				
Vinyl chloride	ND	0.018	ug/L	0.0069
Bromomethane	ND	0.027	ug/L	0.013
Chloroethane	ND	0.038	ug/L	0.0073
Trichlorofluoromethane	ND	0.038	ug/L	0.0097
1,1-Dichloroethene	ND	0.027	ug/L	0.0069
Carbon disulfide	ND	0.11	ug/L	0.021
1,1,2-Trichloro-	ND	0.052	ug/L	0.013
1,2,2-trifluoroethane				
Acetone	ND	0.083	ug/L	0.016
Methylene chloride	ND	0.024	ug/L	0.0097
trans-1,2-Dichloroethene	ND	0.027	ug/L	0.0069
1,1-Dichloroethane	ND	0.028	ug/L	0.0069
Vinyl acetate	ND	0.12	ug/L	0.024
cis-1,2-Dichloroethene	0.032	0.027	ug/L	0.011
2-Butanone (MEK)	ND	0.10	ug/L	0.020
Chloroform	ND	0.034	ug/L	0.013
1,1,1-Trichloroethane	ND	0.038	ug/L	0.0093
Carbon tetrachloride	ND	0.045	ug/L	0.011
Benzene	ND	0.022	ug/L	0.0090
1,2-Dichloroethane	ND	0.028	ug/L	0.011
Trichloroethene	5.8	0.038	ug/L	0.0093
1,2-Dichloropropane	ND	0.032	ug/L	0.013
Bromodichloromethane	ND	0.045	ug/L	0.018
cis-1,3-Dichloropropene	ND	0.031	ug/L	0.0080
4-Methyl-2-pentanone (MIBK)	ND	0.14	ug/L	0.028
Toluene	ND	0.026	ug/L	0.0066
trans-1,3-Dichloropropene	ND	0.031	ug/L	0.012
1,1,2-Trichloroethane	ND	0.038	ug/L	0.011
Tetrachloroethene	ND	0.048	ug/L	0.014
2-Hexanone	ND	0.14	ug/L	0.014
Dibromochloromethane	ND	0.059	ug/L	0.015
1,2-Dibromoethane (EDB)	ND	0.052	ug/L	0.013

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Earth Tech, Inc.

Client Sample ID: CASTL DA4-VW03-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-002 Work Order #....: HDLEG1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	MDL
Chlorobenzene	ND	0.032	ug/L	0.0080
Ethylbenzene	ND	0.030	ug/L	0.0076
m-Xylene & p-Xylene	ND	0.030	ug/L	0.015
o-Xylene	ND	0.030	ug/L	0.0090
Styrene	ND	0.029	ug/L	0.0086
Bromoform	ND	0.027	ug/L	0.013
1,1,2,2-Tetrachloroethane	ND	0.048	ug/L	0.012
Benzyl chloride	ND	0.18	ug/L	0.014
4-Ethyltoluene	ND	0.034	ug/L	0.012
1,3,5-Trimethylbenzene	ND	0.034	ug/L	0.019
1,2,4-Trimethylbenzene	ND	0.034	ug/L	0.022
1,3-Dichlorobenzene	ND	0.042	ug/L	0.015
1,4-Dichlorobenzene	ND	0.042	ug/L	0.017
1,2-Dichlorobenzene	ND	0.042	ug/L	0.018
1,2,4-Trichloro- benzene	ND	0.13	ug/L	0.034
Hexachlorobutadiene	ND	0.15	ug/L	0.045
n-Hexane	ND	0.024	ug/L	0.0073
Total Non-Methane Hydrocarbons as Hexane	1100	6.2	ug/L	1.2

## Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW01-99

## GC/MS Volatiles

Lot-Sample #....: E5F140337-003    Work Order #....: HDLEH1AC    Matrix.....: AE  
 Date Sampled....: 06/08/05 11:40    Date Received...: 06/10/05  
 Prep Date.....: 06/21/05    Analysis Date...: 06/21/05  
 Prep Batch #....: 5173212    Analysis Time...: 14:21  
 Dilution Factor: 20.25  
 Analyst ID.....: 101605    Instrument ID...: MSB  
 Method.....: EPA-19 TO-14A

PARAMETER	REPORTING			
	RESULT	LIMIT	UNITS	MDL
Dichlorodifluoromethane	ND	0.20	ug/L	0.051
Chloromethane	ND	0.17	ug/L	0.043
1,2-Dichloro-	ND	0.28	ug/L	0.11
1,1,2,2-tetrafluoroethane				
Vinyl chloride	ND	0.10	ug/L	0.040
Bromomethane	ND	0.16	ug/L	0.079
Chloroethane	ND	0.22	ug/L	0.043
Trichlorofluoromethane	ND	0.22	ug/L	0.057
1,1-Dichloroethene	ND	0.16	ug/L	0.040
Carbon disulfide	ND	0.63	ug/L	0.13
1,1,2-Trichloro-	ND	0.30	ug/L	0.077
1,2,2-trifluoroethane				
Acetone	ND	0.49	ug/L	0.095
Methylene chloride	ND	0.14	ug/L	0.057
trans-1,2-Dichloroethene	ND	0.16	ug/L	0.040
1,1-Dichloroethane	ND	0.16	ug/L	0.040
Vinyl acetate	ND	0.71	ug/L	0.14
cis-1,2-Dichloroethene	ND	0.16	ug/L	0.065
2-Butanone (MEK)	ND	0.59	ug/L	0.12
Chloroform	ND	0.20	ug/L	0.079
1,1,1-Trichloroethane	ND	0.22	ug/L	0.055
Carbon tetrachloride	ND	0.26	ug/L	0.063
Benzene	ND	0.13	ug/L	0.053
1,2-Dichloroethane	ND	0.16	ug/L	0.065
Trichloroethene	38	0.22	ug/L	0.055
1,2-Dichloropropane	ND	0.19	ug/L	0.075
Bromodichloromethane	ND	0.26	ug/L	0.11
cis-1,3-Dichloropropene	ND	0.18	ug/L	0.047
4-Methyl-2-pentanone	ND	0.83	ug/L	0.17
(MIBK)				
Toluene	ND	0.15	ug/L	0.038
trans-1,3-Dichloropropene	ND	0.18	ug/L	0.073
1,1,2-Trichloroethane	ND	0.22	ug/L	0.067
Tetrachloroethene	ND	0.28	ug/L	0.083
2-Hexanone	ND	0.83	ug/L	0.083
Dibromochloromethane	ND	0.34	ug/L	0.085
1,2-Dibromoethane (EDB)	ND	0.30	ug/L	0.077

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Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW01-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-003 Work Order #....: HDLEH1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	MDL
Chlorobenzene	ND	0.19	ug/L	0.047
Ethylbenzene	ND	0.18	ug/L	0.045
m-Xylene & p-Xylene	ND	0.18	ug/L	0.087
o-Xylene	ND	0.18	ug/L	0.053
Styrene	ND	0.17	ug/L	0.051
Bromoform	ND	0.16	ug/L	0.079
1,1,2,2-Tetrachloroethane	ND	0.28	ug/L	0.069
Benzyl chloride	ND	1.1	ug/L	0.083
4-Ethyltoluene	ND	0.20	ug/L	0.069
1,3,5-Trimethylbenzene	ND	0.20	ug/L	0.11
1,2,4-Trimethylbenzene	ND	0.20	ug/L	0.13
1,3-Dichlorobenzene	ND	0.24	ug/L	0.089
1,4-Dichlorobenzene	ND	0.24	ug/L	0.097
1,2-Dichlorobenzene	ND	0.24	ug/L	0.11
1,2,4-Trichloro- benzene	ND	0.75	ug/L	0.20
Hexachlorobutadiene	ND	0.87	ug/L	0.26
n-Hexane	ND	0.14	ug/L	0.043
Total Non-Methane Hydrocarbons as Hexane	6500	36	ug/L	7.3

Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW02-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-004 Work Order #....: HDLEK1AC Matrix.....: AE  
Date Sampled....: 06/08/05 11:54 Date Received...: 06/10/05  
Prep Date.....: 06/21/05 Analysis Date...: 06/21/05  
Prep Batch #....: 5173212 Analysis Time...: 14:58  
Dilution Factor: 17.09  
Analyst ID.....: 101605 Instrument ID...: MSB  
Method.....: EPA-19 TO-14A

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	MDL
Dichlorodifluoromethane	ND	0.17	ug/L	0.043
Chloromethane	ND	0.14	ug/L	0.036
1,2-Dichloro-	ND	0.24	ug/L	0.096
1,1,2,2-tetrafluoroethane				
Vinyl chloride	ND	0.087	ug/L	0.034
Bromomethane	ND	0.13	ug/L	0.067
Chloroethane	ND	0.19	ug/L	0.036
Trichlorofluoromethane	ND	0.19	ug/L	0.048
1,1-Dichloroethene	ND	0.14	ug/L	0.034
Carbon disulfide	ND	0.53	ug/L	0.11
1,1,2-Trichloro-	ND	0.26	ug/L	0.065
1,2,2-trifluoroethane				
Acetone	ND	0.41	ug/L	0.080
Methylene chloride	ND	0.12	ug/L	0.048
trans-1,2-Dichloroethene	ND	0.14	ug/L	0.034
1,1-Dichloroethane	ND	0.14	ug/L	0.034
Vinyl acetate	ND	0.60	ug/L	0.12
cis-1,2-Dichloroethene	ND	0.14	ug/L	0.055
2-Butanone (MEK)	ND	0.50	ug/L	0.10
Chloroform	ND	0.17	ug/L	0.067
1,1,1-Trichloroethane	ND	0.19	ug/L	0.046
Carbon tetrachloride	ND	0.22	ug/L	0.053
Benzene	ND	0.11	ug/L	0.044
1,2-Dichloroethane	ND	0.14	ug/L	0.055
Trichloroethene	33	0.19	ug/L	0.046
1,2-Dichloropropane	ND	0.16	ug/L	0.063
Bromodichloromethane	ND	0.22	ug/L	0.091
cis-1,3-Dichloropropene	ND	0.16	ug/L	0.039
4-Methyl-2-pentanone	ND	0.70	ug/L	0.14
(MIBK)				
Toluene	ND	0.13	ug/L	0.032
trans-1,3-Dichloropropene	ND	0.16	ug/L	0.062
1,1,2-Trichloroethane	ND	0.19	ug/L	0.056
Tetrachloroethene	ND	0.24	ug/L	0.070
2-Hexanone	ND	0.70	ug/L	0.070
Dibromochloromethane	ND	0.29	ug/L	0.072
1,2-Dibromoethane (EDB)	ND	0.26	ug/L	0.065

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Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW02-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-004 Work Order #....: HDLEK1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Chlorobenzene	ND	0.16	ug/L	0.039
Ethylbenzene	ND	0.15	ug/L	0.038
m-Xylene & p-Xylene	ND	0.15	ug/L	0.073
o-Xylene	ND	0.15	ug/L	0.044
Styrene	ND	0.15	ug/L	0.043
Bromoform	ND	0.13	ug/L	0.067
1,1,2,2-Tetrachloroethane	ND	0.24	ug/L	0.058
Benzyl chloride	ND	0.89	ug/L	0.070
4-Ethyltoluene	ND	0.17	ug/L	0.058
1,3,5-Trimethylbenzene	ND	0.17	ug/L	0.092
1,2,4-Trimethylbenzene	ND	0.17	ug/L	0.11
1,3-Dichlorobenzene	ND	0.21	ug/L	0.075
1,4-Dichlorobenzene	ND	0.21	ug/L	0.082
1,2-Dichlorobenzene	ND	0.21	ug/L	0.091
1,2,4-Trichloro- benzene	ND	0.63	ug/L	0.17
Hexachlorobutadiene	ND	0.73	ug/L	0.22
n-Hexane	ND	0.12	ug/L	0.036
Total Non-Methane Hydrocarbons as Hexane	5400	31	ug/L	6.2

Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW16-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-005 Work Order #....: HDLEL1AC Matrix.....: AE  
Date Sampled....: 06/08/05 12:28 Date Received...: 06/10/05  
Prep Date.....: 06/21/05 Analysis Date...: 06/21/05  
Prep Batch #....: 5173212 Analysis Time...: 15:35  
Dilution Factor: 1.69  
Analyst ID.....: 101605 Instrument ID...: MSB  
Method.....: EPA-19 TO-14A

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	MDL
Dichlorodifluoromethane	ND	0.017	ug/L	0.0042
Chloromethane	ND	0.014	ug/L	0.0035
1,2-Dichloro-	ND	0.024	ug/L	0.0095
1,1,2,2-tetrafluoroethane				
Vinyl chloride	ND	0.0086	ug/L	0.0034
Bromomethane	ND	0.013	ug/L	0.0066
Chloroethane	ND	0.019	ug/L	0.0035
Trichlorofluoromethane	ND	0.019	ug/L	0.0047
1,1-Dichloroethene	ND	0.013	ug/L	0.0034
Carbon disulfide	ND	0.052	ug/L	0.010
1,1,2-Trichloro-	ND	0.025	ug/L	0.0064
1,2,2-trifluoroethane				
Acetone	ND	0.041	ug/L	0.0079
Methylene chloride	ND	0.012	ug/L	0.0047
trans-1,2-Dichloroethene	ND	0.013	ug/L	0.0034
1,1-Dichloroethane	ND	0.014	ug/L	0.0034
Vinyl acetate	ND	0.059	ug/L	0.012
cis-1,2-Dichloroethene	0.049	0.013	ug/L	0.0054
2-Butanone (MEK)	ND	0.049	ug/L	0.010
Chloroform	0.0070 J	0.016	ug/L	0.0066
1,1,1-Trichloroethane	ND	0.019	ug/L	0.0046
Carbon tetrachloride	ND	0.022	ug/L	0.0052
Benzene	ND	0.011	ug/L	0.0044
1,2-Dichloroethane	ND	0.014	ug/L	0.0054
Trichloroethene	2.4	0.019	ug/L	0.0046
1,2-Dichloropropane	ND	0.016	ug/L	0.0063
Bromodichloromethane	ND	0.022	ug/L	0.0090
cis-1,3-Dichloropropene	ND	0.015	ug/L	0.0039
4-Methyl-2-pentanone	ND	0.069	ug/L	0.014
(MIBK)				
Toluene	ND	0.013	ug/L	0.0032
trans-1,3-Dichloropropene	ND	0.015	ug/L	0.0061
1,1,2-Trichloroethane	ND	0.019	ug/L	0.0056
Tetrachloroethene	ND	0.024	ug/L	0.0069
2-Hexanone	ND	0.069	ug/L	0.0069
Dibromochloromethane	ND	0.029	ug/L	0.0071
1,2-Dibromoethane (EDB)	ND	0.025	ug/L	0.0064

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Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW16-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-005 Work Order #....: HDLEL1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	MDL
Chlorobenzene	ND	0.016	ug/L	0.0039
Ethylbenzene	ND	0.015	ug/L	0.0037
m-Xylene & p-Xylene	ND	0.015	ug/L	0.0073
o-Xylene	ND	0.015	ug/L	0.0044
Styrene	ND	0.014	ug/L	0.0042
Bromoform	ND	0.013	ug/L	0.0066
1,1,2,2-Tetrachloroethane	ND	0.024	ug/L	0.0057
Benzyl chloride	ND	0.088	ug/L	0.0069
4-Ethyltoluene	ND	0.017	ug/L	0.0057
1,3,5-Trimethylbenzene	ND	0.017	ug/L	0.0091
1,2,4-Trimethylbenzene	ND	0.017	ug/L	0.011
1,3-Dichlorobenzene	ND	0.020	ug/L	0.0074
1,4-Dichlorobenzene	ND	0.020	ug/L	0.0081
1,2-Dichlorobenzene	ND	0.020	ug/L	0.0090
1,2,4-Trichloro- benzene	ND	0.063	ug/L	0.016
Hexachlorobutadiene	ND	0.073	ug/L	0.022
n-Hexane	ND	0.012	ug/L	0.0035
Total Non-Methane Hydrocarbons as Hexane	430	3.0	ug/L	0.61

NOTE (S) :

J Estimated result. Result is less than RL.

Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW04-98

GC/MS Volatiles

Lot-Sample #....: E5F140337-006 Work Order #....: HDLEN1AC Matrix.....: AE  
Date Sampled....: 06/08/05 13:15 Date Received...: 06/10/05  
Prep Date.....: 06/21/05 Analysis Date...: 06/21/05  
Prep Batch #....: 5173212 Analysis Time...: 16:12  
Dilution Factor: 8.66  
Analyst ID.....: 101605 Instrument ID...: MSB  
Method.....: EPA-19 TO-14A

PARAMETER	REPORTING			
	RESULT	LIMIT	UNITS	MDL
Dichlorodifluoromethane	ND	0.086	ug/L	0.022
Chloromethane	ND	0.071	ug/L	0.018
1,2-Dichloro-	ND	0.12	ug/L	0.048
1,1,2,2-tetrafluoroethane				
Vinyl chloride	ND	0.044	ug/L	0.017
Bromomethane	ND	0.068	ug/L	0.034
Chloroethane	ND	0.095	ug/L	0.018
Trichlorofluoromethane	ND	0.095	ug/L	0.024
1,1-Dichloroethene	ND	0.068	ug/L	0.017
Carbon disulfide	ND	0.27	ug/L	0.054
1,1,2-Trichloro-	ND	0.13	ug/L	0.033
1,2,2-trifluoroethane				
Acetone	ND	0.21	ug/L	0.041
Methylene chloride	ND	0.060	ug/L	0.024
trans-1,2-Dichloroethene	ND	0.068	ug/L	0.017
1,1-Dichloroethane	ND	0.070	ug/L	0.017
Vinyl acetate	ND	0.30	ug/L	0.061
cis-1,2-Dichloroethene	ND	0.068	ug/L	0.028
2-Butanone (MEK)	ND	0.25	ug/L	0.051
Chloroform	ND	0.084	ug/L	0.034
1,1,1-Trichloroethane	ND	0.095	ug/L	0.023
Carbon tetrachloride	ND	0.11	ug/L	0.027
Benzene	ND	0.055	ug/L	0.023
1,2-Dichloroethane	ND	0.070	ug/L	0.028
Trichloroethene	20	0.095	ug/L	0.023
1,2-Dichloropropane	ND	0.080	ug/L	0.032
Bromodichloromethane	ND	0.11	ug/L	0.046
cis-1,3-Dichloropropene	ND	0.079	ug/L	0.020
4-Methyl-2-pentanone	ND	0.36	ug/L	0.071
(MIBK)				
Toluene	ND	0.065	ug/L	0.016
trans-1,3-Dichloropropene	ND	0.079	ug/L	0.031
1,1,2-Trichloroethane	ND	0.095	ug/L	0.029
Tetrachloroethene	ND	0.12	ug/L	0.036
2-Hexanone	ND	0.36	ug/L	0.036
Dibromochloromethane	ND	0.15	ug/L	0.036
1,2-Dibromoethane (EDB)	ND	0.13	ug/L	0.033

(Continued on next page)

Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW04-98

GC/MS Volatiles

Lot-Sample #....: E5F140337-006 Work Order #....: HDLEN1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	MDL
Chlorobenzene	ND	0.080	ug/L	0.020
Ethylbenzene	ND	0.075	ug/L	0.019
m-Xylene & p-Xylene	ND	0.075	ug/L	0.037
o-Xylene	ND	0.075	ug/L	0.023
Styrene	ND	0.074	ug/L	0.022
Bromoform	ND	0.068	ug/L	0.034
1,1,2,2-Tetrachloroethane	ND	0.12	ug/L	0.029
Benzyl chloride	ND	0.45	ug/L	0.036
4-Ethyltoluene	ND	0.085	ug/L	0.029
1,3,5-Trimethylbenzene	ND	0.085	ug/L	0.047
1,2,4-Trimethylbenzene	ND	0.085	ug/L	0.055
1,3-Dichlorobenzene	ND	0.10	ug/L	0.038
1,4-Dichlorobenzene	ND	0.10	ug/L	0.042
1,2-Dichlorobenzene	ND	0.10	ug/L	0.046
1,2,4-Trichloro- benzene	ND	0.32	ug/L	0.084
Hexachlorobutadiene	ND	0.37	ug/L	0.11
n-Hexane	ND	0.061	ug/L	0.018
Total Non-Methane Hydrocarbons as Hexane	3400	16	ug/L	3.1

## Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW04-99

## GC/MS Volatiles

Lot-Sample #....: E5F140337-007 Work Order #....: HDLEP1AC Matrix.....: AE  
 Date Sampled....: 06/08/05 13:15 Date Received...: 06/10/05  
 Prep Date.....: 06/21/05 Analysis Date...: 06/21/05  
 Prep Batch #....: 5173212 Analysis Time...: 16:49  
 Dilution Factor: 8.65  
 Analyst ID.....: 101605 Instrument ID...: MSB  
 Method.....: EPA-19 TO-14A

PARAMETER	REPORTING			
	RESULT	LIMIT	UNITS	MDL
Dichlorodifluoromethane	ND	0.086	ug/L	0.022
Chloromethane	ND	0.071	ug/L	0.018
1,2-Dichloro-	ND	0.12	ug/L	0.048
1,1,2,2-tetrafluoroethane				
Vinyl chloride	ND	0.044	ug/L	0.017
Bromomethane	ND	0.067	ug/L	0.034
Chloroethane	ND	0.095	ug/L	0.018
Trichlorofluoromethane	ND	0.095	ug/L	0.024
1,1-Dichloroethene	ND	0.068	ug/L	0.017
Carbon disulfide	ND	0.27	ug/L	0.054
1,1,2-Trichloro-	ND	0.13	ug/L	0.033
1,2,2-trifluoroethane				
Acetone	ND	0.21	ug/L	0.041
Methylene chloride	ND	0.060	ug/L	0.024
trans-1,2-Dichloroethene	ND	0.068	ug/L	0.017
1,1-Dichloroethane	ND	0.070	ug/L	0.017
Vinyl acetate	ND	0.30	ug/L	0.061
cis-1,2-Dichloroethene	ND	0.068	ug/L	0.028
2-Butanone (MEK)	ND	0.25	ug/L	0.051
Chloroform	ND	0.084	ug/L	0.034
1,1,1-Trichloroethane	ND	0.095	ug/L	0.023
Carbon tetrachloride	ND	0.11	ug/L	0.027
Benzene	ND	0.055	ug/L	0.022
1,2-Dichloroethane	ND	0.070	ug/L	0.028
Trichloroethene	20	0.095	ug/L	0.023
1,2-Dichloropropane	ND	0.080	ug/L	0.032
Bromodichloromethane	ND	0.11	ug/L	0.046
cis-1,3-Dichloropropene	ND	0.079	ug/L	0.020
4-Methyl-2-pentanone	ND	0.35	ug/L	0.071
(MIBK)				
Toluene	ND	0.065	ug/L	0.016
trans-1,3-Dichloropropene	ND	0.079	ug/L	0.031
1,1,2-Trichloroethane	ND	0.095	ug/L	0.029
Tetrachloroethene	ND	0.12	ug/L	0.035
2-Hexanone	ND	0.35	ug/L	0.035
Dibromochloromethane	ND	0.15	ug/L	0.036
1,2-Dibromoethane (EDB)	ND	0.13	ug/L	0.033

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Earth Tech, Inc.

Client Sample ID: CASTL-DA4-VW04-99

GC/MS Volatiles

Lot-Sample #....: E5F140337-007 Work Order #....: HDLEP1AC Matrix.....: AE

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Chlorobenzene	ND	0.080	ug/L	0.020
Ethylbenzene	ND	0.075	ug/L	0.019
m-Xylene & p-Xylene	ND	0.075	ug/L	0.037
o-Xylene	ND	0.075	ug/L	0.022
Styrene	ND	0.074	ug/L	0.022
Bromoform	ND	0.067	ug/L	0.034
1,1,2,2-Tetrachloroethane	ND	0.12	ug/L	0.029
Benzyl chloride	ND	0.45	ug/L	0.035
4-Ethyltoluene	ND	0.085	ug/L	0.029
1,3,5-Trimethylbenzene	ND	0.085	ug/L	0.047
1,2,4-Trimethylbenzene	ND	0.085	ug/L	0.054
1,3-Dichlorobenzene	ND	0.10	ug/L	0.038
1,4-Dichlorobenzene	ND	0.10	ug/L	0.042
1,2-Dichlorobenzene	ND	0.10	ug/L	0.046
1,2,4-Trichloro- benzene	ND	0.32	ug/L	0.084
Hexachlorobutadiene	ND	0.37	ug/L	0.11
n-Hexane	ND	0.061	ug/L	0.018
Total Non-Methane Hydrocarbons as Hexane	3400	16	ug/L	3.1

**SEVERN  
TRENT** STL

QA/QC

## QC DATA ASSOCIATION SUMMARY

E5F140337

### Sample Preparation and Analysis Control Numbers

<u>SAMPLE#</u>	<u>MATRIX</u>	<u>ANALYTICAL METHOD</u>	<u>LEACH BATCH #</u>	<u>PREP BATCH #</u>	<u>MS RUN#</u>
001	AE	EPA-19 TO-14A		5173212	
002	AE	EPA-19 TO-14A		5173212	
003	AE	EPA-19 TO-14A		5173212	
004	AE	EPA-19 TO-14A		5173212	
005	AE	EPA-19 TO-14A		5173212	
006	AE	EPA-19 TO-14A		5173212	
007	AE	EPA-19 TO-14A		5173212	

**METHOD BLANK REPORT**

**GC/MS Volatiles**

<b>Client Lot #....:</b> E5F140337	<b>Work Order #....:</b> HD46M1AA	<b>Matrix.....:</b> AIR
<b>MB Lot-Sample #:</b> M5F220000-212		
	<b>Prep Date.....:</b> 06/21/05	<b>Analysis Time..:</b> 09:13
<b>Analysis Date...:</b> 06/21/05	<b>Prep Batch #....:</b> 5173212	<b>Instrument ID..:</b> MSB
<b>Dilution Factor:</b> 1		
	<b>Analyst ID.....:</b> 101605	

PARAMETER	RESULT	REPORTING		
		LIMIT	UNITS	METHOD
Dichlorodifluoromethane	ND	0.0099	ug/L	EPA-19 TO-14A
Chloromethane	ND	0.0082	ug/L	EPA-19 TO-14A
1,2-Dichloro-	ND	0.014	ug/L	EPA-19 TO-14A
1,1,2,2-tetrafluoroethane				
Vinyl chloride	ND	0.0051	ug/L	EPA-19 TO-14A
Bromomethane	ND	0.0078	ug/L	EPA-19 TO-14A
Chloroethane	ND	0.011	ug/L	EPA-19 TO-14A
Trichlorofluoromethane	ND	0.011	ug/L	EPA-19 TO-14A
1,1-Dichloroethene	ND	0.0079	ug/L	EPA-19 TO-14A
Carbon disulfide	ND	0.031	ug/L	EPA-19 TO-14A
1,1,2-Trichloro-	ND	0.015	ug/L	EPA-19 TO-14A
1,2,2-trifluoroethane				
Acetone	ND	0.024	ug/L	EPA-19 TO-14A
Methylene chloride	ND	0.0069	ug/L	EPA-19 TO-14A
trans-1,2-Dichloroethene	ND	0.0079	ug/L	EPA-19 TO-14A
1,1-Dichloroethane	ND	0.0081	ug/L	EPA-19 TO-14A
Vinyl acetate	ND	0.035	ug/L	EPA-19 TO-14A
cis-1,2-Dichloroethene	ND	0.0079	ug/L	EPA-19 TO-14A
2-Butanone (MEK)	ND	0.029	ug/L	EPA-19 TO-14A
Chloroform	ND	0.0097	ug/L	EPA-19 TO-14A
1,1,1-Trichloroethane	ND	0.011	ug/L	EPA-19 TO-14A
Carbon tetrachloride	ND	0.013	ug/L	EPA-19 TO-14A
Benzene	ND	0.0064	ug/L	EPA-19 TO-14A
1,2-Dichloroethane	ND	0.0081	ug/L	EPA-19 TO-14A
Trichloroethene	ND	0.011	ug/L	EPA-19 TO-14A
1,2-Dichloropropane	ND	0.0092	ug/L	EPA-19 TO-14A
Bromodichloromethane	ND	0.013	ug/L	EPA-19 TO-14A
cis-1,3-Dichloropropene	ND	0.0091	ug/L	EPA-19 TO-14A
4-Methyl-2-pentanone (MIBK)	ND	0.041	ug/L	EPA-19 TO-14A
Toluene	ND	0.0075	ug/L	EPA-19 TO-14A
trans-1,3-Dichloropropene	ND	0.0091	ug/L	EPA-19 TO-14A
1,1,2-Trichloroethane	ND	0.011	ug/L	EPA-19 TO-14A
Tetrachloroethene	ND	0.014	ug/L	EPA-19 TO-14A
2-Hexanone	ND	0.041	ug/L	EPA-19 TO-14A
Dibromochloromethane	ND	0.017	ug/L	EPA-19 TO-14A
1,2-Dibromoethane (EDB)	ND	0.015	ug/L	EPA-19 TO-14A
Chlorobenzene	ND	0.0092	ug/L	EPA-19 TO-14A
Ethylbenzene	ND	0.0087	ug/L	EPA-19 TO-14A
m-Xylene & p-Xylene	ND	0.0087	ug/L	EPA-19 TO-14A

(Continued on next page)

**METHOD BLANK REPORT**

**GC/MS Volatiles**

**Client Lot #....: E5F140337**

**Work Order #....: HD46M1AA**

**Matrix.....: AIR**

<b>PARAMETER</b>	<b>RESULT</b>	<b>REPORTING</b>		
		<b>LIMIT</b>	<b>UNITS</b>	<b>METHOD</b>
o-Xylene	ND	0.0087	ug/L	EPA-19 TO-14A
Styrene	ND	0.0085	ug/L	EPA-19 TO-14A
Bromoform	ND	0.0078	ug/L	EPA-19 TO-14A
1,1,2,2-Tetrachloroethane	ND	0.014	ug/L	EPA-19 TO-14A
Benzyl chloride	ND	0.052	ug/L	EPA-19 TO-14A
4-Ethyltoluene	ND	0.0098	ug/L	EPA-19 TO-14A
1,3,5-Trimethylbenzene	ND	0.0098	ug/L	EPA-19 TO-14A
1,2,4-Trimethylbenzene	ND	0.0098	ug/L	EPA-19 TO-14A
1,3-Dichlorobenzene	ND	0.012	ug/L	EPA-19 TO-14A
1,4-Dichlorobenzene	ND	0.012	ug/L	EPA-19 TO-14A
1,2-Dichlorobenzene	ND	0.012	ug/L	EPA-19 TO-14A
1,2,4-Trichloro- benzene	ND	0.037	ug/L	EPA-19 TO-14A
Hexachlorobutadiene	ND	0.043	ug/L	EPA-19 TO-14A
n-Hexane	ND	0.0070	ug/L	EPA-19 TO-14A
Total Non-Methane Hydrocarbons	ND	1.8	ug/L	EPA-19 TO-14A

**NOTE (S) :**

Calculations are performed before rounding to avoid round-off errors in calculated results.

**LABORATORY CONTROL SAMPLE EVALUATION REPORT**

**GC/MS Volatiles**

Client Lot #....: E5F140337      Work Order #....: HD46M1AC-LCS      Matrix.....: AIR  
 LCS Lot-Sample#: M5F220000-212           HD46M1AD-LCSD  
 Prep Date.....: 06/21/05      Analysis Date...: 06/21/05  
 Prep Batch #....: 5173212      Analysis Time...: 07:18  
 Dilution Factor: 1      Instrument ID...: MSB  
 Analyst ID.....: 101605

<u>PARAMETER</u>	<u>PERCENT</u>	<u>RECOVERY</u>	<u>RPD</u>	<u>LIMITS</u>	<u>METHOD</u>
	<u>RECOVERY</u>	<u>LIMITS</u>			
1,1-Dichloroethene	101	(70 - 125)			EPA-19 TO-14A
	99	(70 - 125)	1.1	(0-20)	EPA-19 TO-14A
Methylene chloride	103	(75 - 120)			EPA-19 TO-14A
	101	(75 - 120)	1.5	(0-20)	EPA-19 TO-14A
Trichloroethene	103	(70 - 125)			EPA-19 TO-14A
	101	(70 - 125)	1.3	(0-20)	EPA-19 TO-14A
Toluene	103	(75 - 125)			EPA-19 TO-14A
	102	(75 - 125)	0.95	(0-20)	EPA-19 TO-14A
1,1,2,2-Tetrachloroethane	102	(65 - 130)			EPA-19 TO-14A
	100	(65 - 130)	1.5	(0-20)	EPA-19 TO-14A

**NOTE (S) :**

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

## LABORATORY CONTROL SAMPLE DATA REPORT

### GC/MS Volatiles

Client Lot #....: E5F140337      Work Order #....: HD46M1AC-LCS      Matrix.....: AIR  
 LCS Lot-Sample#: M5F220000-212      HD46M1AD-LCSD  
 Prep Date.....: 06/21/05      Analysis Date...: 06/21/05  
 Prep Batch #....: 5173212      Analysis Time...: 07:18  
 Dilution Factor: 1      Instrument ID...: MSB  
 Analyst ID.....: 101605

PARAMETER	SPIKE	MEASURED	UNITS	PERCENT	RPD	METHOD
	AMOUNT	AMOUNT		RECOVERY		
1,1-Dichloroethene	0.198	0.199	ug/L	101		EPA-19 TO-14A
	0.198	0.197	ug/L	99	1.1	EPA-19 TO-14A
Methylene chloride	0.173	0.178	ug/L	103		EPA-19 TO-14A
	0.173	0.175	ug/L	101	1.5	EPA-19 TO-14A
Trichloroethene	0.268	0.275	ug/L	103		EPA-19 TO-14A
	0.268	0.272	ug/L	101	1.3	EPA-19 TO-14A
Toluene	0.188	0.195	ug/L	103		EPA-19 TO-14A
	0.188	0.193	ug/L	102	0.95	EPA-19 TO-14A
1,1,2,2-Tetrachloroethane	0.343	0.349	ug/L	102		EPA-19 TO-14A
	0.343	0.344	ug/L	100	1.5	EPA-19 TO-14A

#### NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

**APPENDIX B**  
**WASTE DATA FORMS**

# STURGEON & SON, INC.

## TRANSPORTATION SERVICES

3511 Gilmore Avenue • Bakersfield, CA 93308 • (800) 328-6644

10/93

### NON-HAZARDOUS WASTE DATA FORM

**NOTE:** This form to be in lieu of the Department of Toxic Substance Controls hazardous waste manifest. To be used for NON-HAZARDOUS WASTES only.

Name : \_\_\_\_\_

Mailing Address : \_\_\_\_\_

City / State / Zip : \_\_\_\_\_

Phone No : \_\_\_\_\_ Contact : \_\_\_\_\_

Signature: X Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

#### **THE GENERATOR CERTIFIES THAT THE WASTE AS DESCRIBED IS 100% NON-HAZARDOUS**

Waste Description : \_\_\_\_\_

Generating Location : \_\_\_\_\_

Handling Instructions : \_\_\_\_\_

Quantity : \_\_\_\_\_ [ ] BBL [ ] GLS [ ] YDS [ ] TONS

CONTAINER TYPE: [ ] TANK TRUCK [ ] DUMP TRUCK [ ] DRUMS [ ] BINS [ ] OTHER \_\_\_\_\_

#### **DESIGNATED FACILITY :**

NAME : \_\_\_\_\_ ADDRESS : \_\_\_\_\_

CITY/STATE/ZIP: \_\_\_\_\_ PHONE # : \_\_\_\_\_

STURGEON & SON, INC.  
TRANSPORTATION SERVICES  
3511 Gilmore Avenue  
Bakersfield, CA 93308  
(800) 328-6644

TICKET #: \_\_\_\_\_ TRACT/TRLR #: \_\_\_\_\_

Bin #'s: \_\_\_\_\_

Signature: \_\_\_\_\_

PU Date: \_\_\_\_\_

#### **RECEIVING FACILITY**

Name: \_\_\_\_\_

#### **Disposal Method:**

Address: \_\_\_\_\_  Landfill Other \_\_\_\_\_

City/State/Zip: \_\_\_\_\_

Phone No: \_\_\_\_\_

Discrepancy: \_\_\_\_\_

Time: \_\_\_\_\_ am/pm

Signature: \_\_\_\_\_

Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

# STURGEON & SON, INC.

## TRANSPORTATION SERVICES

3511 Gilmore Avenue • Bakersfield, CA 93308 • (800) 328-6644

10293

### NON-HAZARDOUS WASTE DATA FORM

**NOTE:** This form to be in lieu of the Department of Toxic Substance Controls hazardous waste manifest. To be used for NON-HAZARDOUS WASTES only.

Name : John D. Sturgeon

Mailing Address : 3511 Gilmore Avenue

City / State / Zip : Bakersfield, CA 93308

Phone No : (800) 328-6644 Contact : John D. Sturgeon

Signature: X Date: 10/12/01

#### THE GENERATOR CERTIFIES THAT THE WASTE AS DESCRIBED IS 100% NON-HAZARDOUS

Waste Description : Non-hazardous

Generating Location : 3511 Gilmore Avenue

Handling Instructions : None

Quantity : 200 [ ]BBL [ ]GLS [ ]YDS [ ]TONS

CONTAINER TYPE: [ ]TANK TRUCK [ ]DUMP TRUCK [ ]DRUMS [ ]BINS [ ]OTHER \_\_\_\_\_

#### DESIGNATED FACILITY :

NAME : John D. Sturgeon ADDRESS : 3511 Gilmore Avenue

CITY/STATE/ZIP: Bakersfield, CA PHONE # : (800) 328-6644

STURGEON & SON, INC.  
TRANSPORTATION SERVICES  
3511 Gilmore Avenue  
Bakersfield, CA 93308  
(800) 328-6644

TICKET #: 10293 TRACT/TRLR # 101 / 1

Bin #'s: \_\_\_\_\_

Signature: John D. Sturgeon

PU Date: 10/12/01

#### RECEIVING FACILITY

Name: \_\_\_\_\_

#### Disposal Method:

Address: \_\_\_\_\_

Landfill Other \_\_\_\_\_

City/State/Zip: \_\_\_\_\_

Phone No: \_\_\_\_\_

Discrepancy: \_\_\_\_\_

Time: \_\_\_\_\_ am/pm

Signature: \_\_\_\_\_

Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

# STURGEON & SON, INC.

## TRANSPORTATION SERVICES

3511 Gilmore Avenue • Bakersfield, CA 93308 • (800) 328-6644

10293

### NON-HAZARDOUS WASTE DATA FORM

**NOTE:** This form to be in lieu of the Department of Toxic Substance Controls hazardous waste manifest. To be used for NON-HAZARDOUS WASTES only.

~~~~~  
Name : \_\_\_\_\_  
Mailing Address : \_\_\_\_\_  
City / State / Zip : \_\_\_\_\_  
Phone No : \_\_\_\_\_ Contact : \_\_\_\_\_  
Signature: X Date: 10 / 20 / 03

**THE GENERATOR CERTIFIES THAT THE WASTE AS DESCRIBED IS 100% NON-HAZARDOUS**

Waste Description : \_\_\_\_\_  
Generating Location : \_\_\_\_\_  
Handling Instructions : \_\_\_\_\_  
Quantity : \_\_\_\_\_ [ ]BBL [ ]GLS [ ]YDS [ ]TONS  
CONTAINER TYPE: [ ]TANK TRUCK [ ]DUMP TRUCK [ ]DRUMS [ ]BINS [ ]OTHER \_\_\_\_\_

**DESIGNATED FACILITY :**

NAME : \_\_\_\_\_ ADDRESS : \_\_\_\_\_  
CITY/STATE/ZIP: \_\_\_\_\_ PHONE # : \_\_\_\_\_

STURGEON & SON, INC.  
TRANSPORTATION SERVICES  
3511 Gilmore Avenue  
Bakersfield, CA 93308  
(800) 328-6644

TICKET #: \_\_\_\_\_ TRACT/TRLR # \_\_\_\_\_ / \_\_\_\_\_  
Bin #'s: \_\_\_\_\_  
Signature: \_\_\_\_\_  
PU Date: \_\_\_\_\_

**RECEIVING FACILITY**

Name: \_\_\_\_\_ **Disposal Method:** \_\_\_\_\_  
Address: \_\_\_\_\_  Landfill Other \_\_\_\_\_  
City/State/Zip: \_\_\_\_\_  
Phone No: \_\_\_\_\_ Time: \_\_\_\_\_ am/pm  
Discrepancy: \_\_\_\_\_  
Signature: \_\_\_\_\_ Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

# STURGEON & SON, INC.

## TRANSPORTATION SERVICES

3511 Gilmore Avenue • Bakersfield, CA 93308 • (800) 328-6644

10294

### NON-HAZARDOUS WASTE DATA FORM

**NOTE:** This form to be in lieu of the Department of Toxic Substance Controls hazardous waste manifest. To be used for NON-HAZARDOUS WASTES only.

Name : \_\_\_\_\_

Mailing Address : \_\_\_\_\_

City / State / Zip : \_\_\_\_\_

Phone No : \_\_\_\_\_ Contact : \_\_\_\_\_

Signature: X Date: 10/10/01

#### THE GENERATOR CERTIFIES THAT THE WASTE AS DESCRIBED IS 100% NON-HAZARDOUS

Waste Description : \_\_\_\_\_

Generating Location : \_\_\_\_\_

Handling Instructions : \_\_\_\_\_

Quantity : \_\_\_\_\_ [ ] BBL [ ] GLS [ ] YDS [ ] TONS

CONTAINER TYPE: [ ] TANK TRUCK [ ] DUMP TRUCK [ ] DRUMS [ ] BINS [ ] OTHER \_\_\_\_\_

#### DESIGNATED FACILITY :

NAME : \_\_\_\_\_ ADDRESS : \_\_\_\_\_

CITY/STATE/ZIP: \_\_\_\_\_ PHONE # : \_\_\_\_\_

STURGEON & SON, INC.  
TRANSPORTATION SERVICES  
3511 Gilmore Avenue  
Bakersfield, CA 93308  
(800) 328-6644

TICKET #: \_\_\_\_\_ TRACT/TRLR # \_\_\_\_\_ / \_\_\_\_\_

Bin #'s: \_\_\_\_\_

Signature: \_\_\_\_\_

PU Date: \_\_\_\_\_

#### RECEIVING FACILITY

Name: \_\_\_\_\_

#### Disposal Method:

Address: \_\_\_\_\_  Landfill Other \_\_\_\_\_

City/State/Zip: \_\_\_\_\_

Phone No: \_\_\_\_\_

Time: \_\_\_\_\_ am/pm

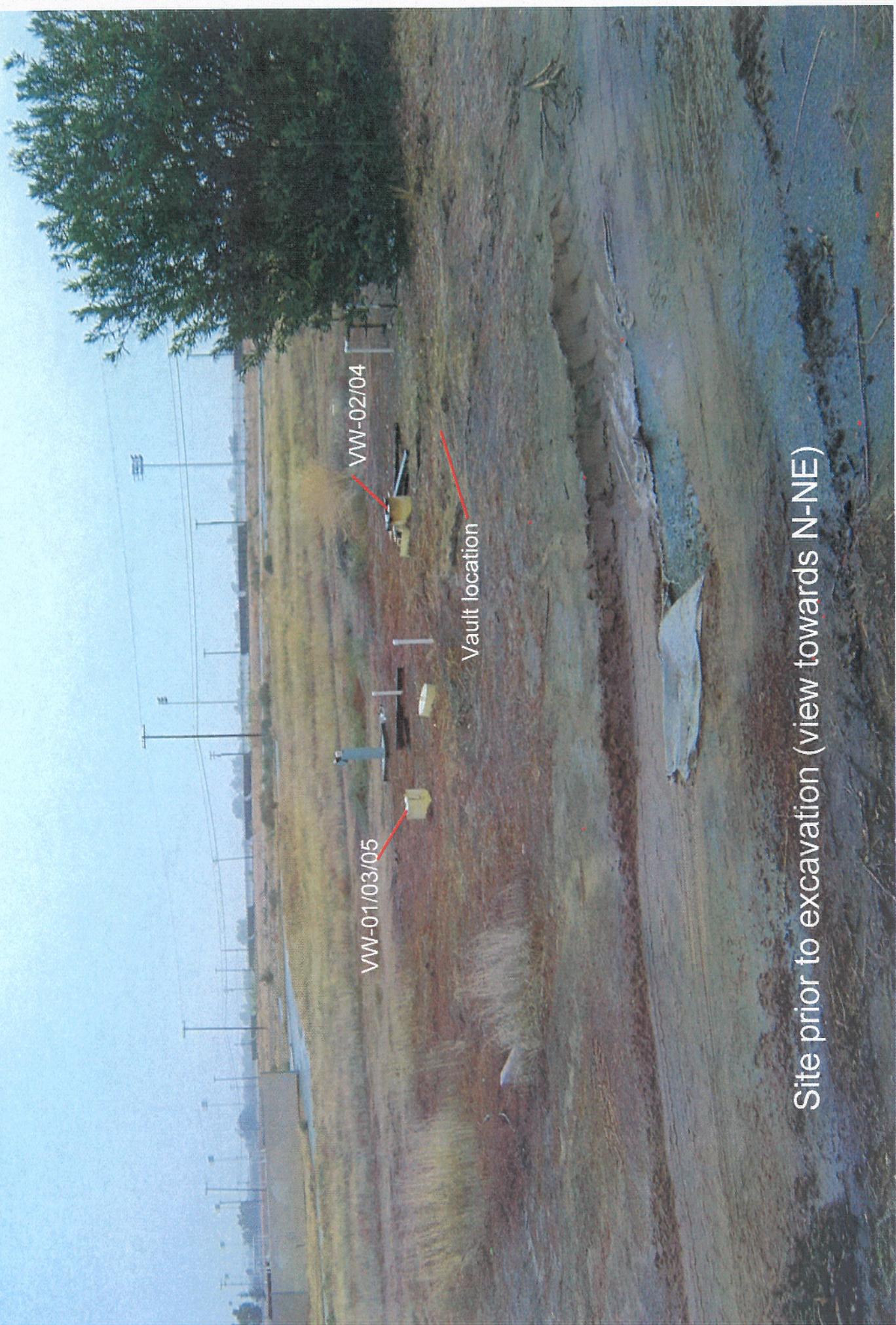
Discrepancy: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

**APPENDIX C**  
**EXCAVATION PHOTOS**

Site prior to excavation (view towards N-NE)



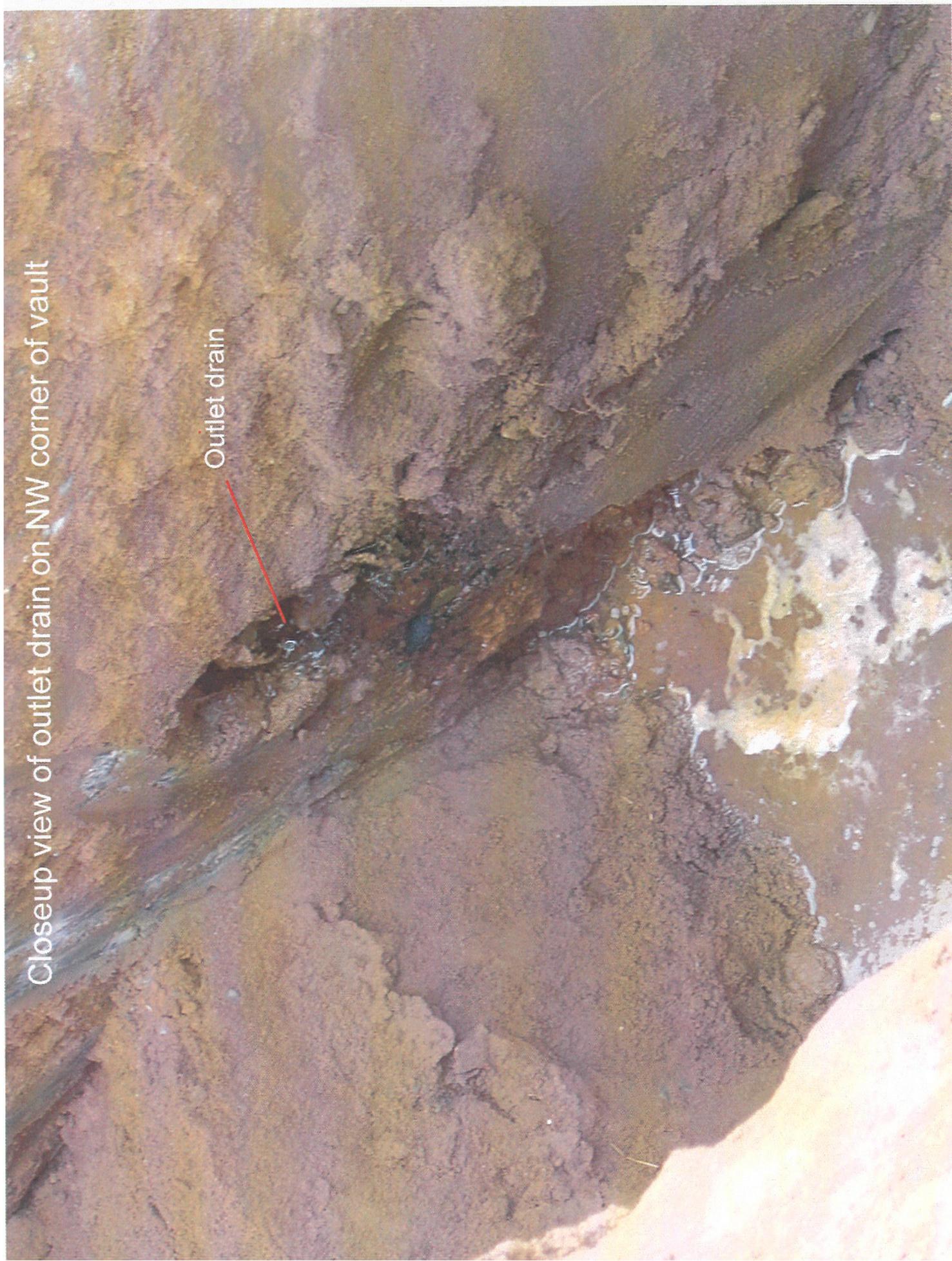
Excavating vault (view towards N-NE)



*View of vault towards the NE*



Closeup view of outlet drain on NW corner of vault



Debris inside vault (view towards NE)



Demolition of Vault (view towards SE)

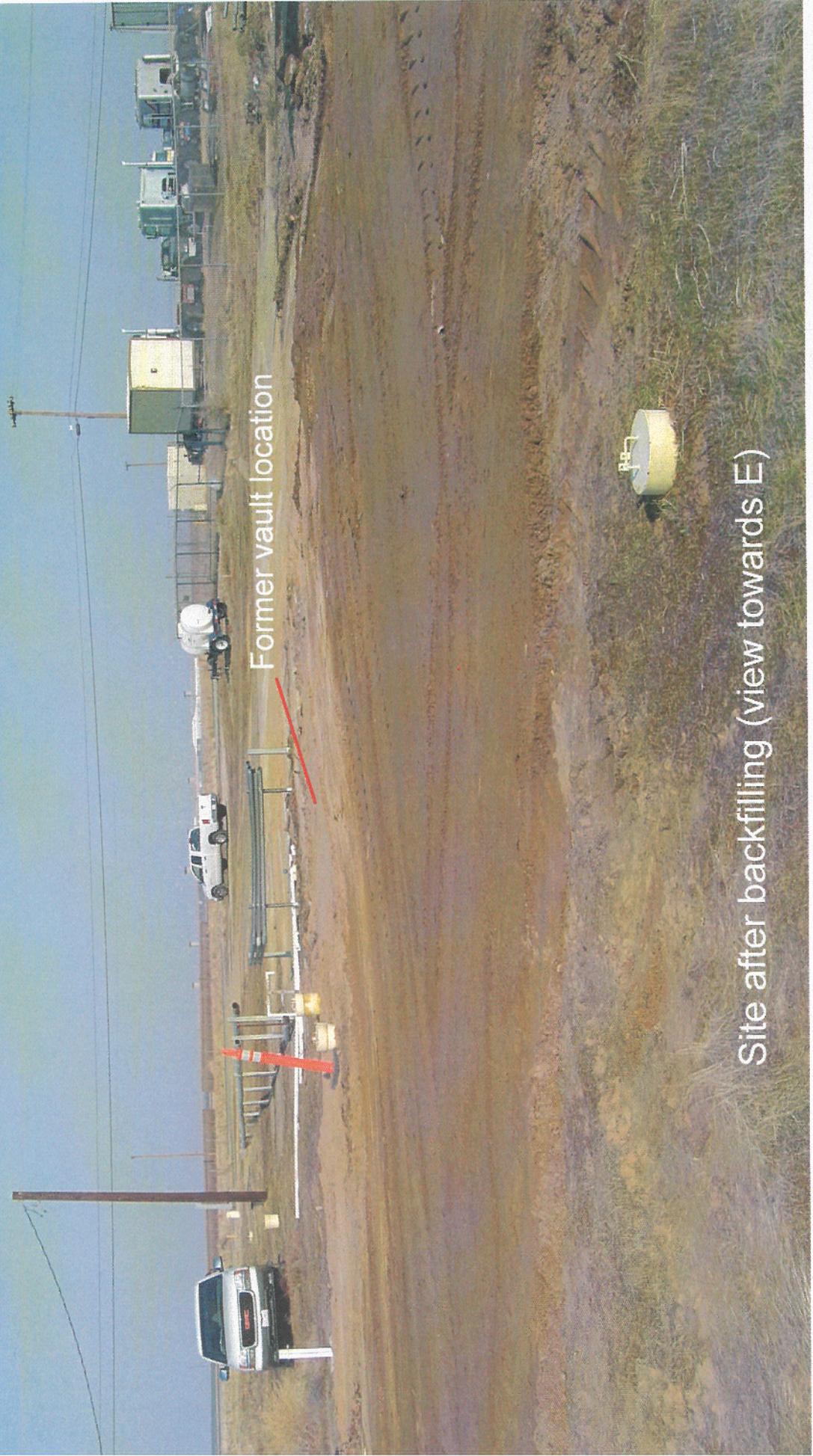




Excavation after vault removal (view towards S)

Site after backfilling (view towards E)

Former vault location



**APPENDIX D**  
**INDOOR AIR EVALUATION**

## **SCREENING EVALUATION**

**Vapor Intrusion Screening Evaluation**  
**Discharge Area 4**  
**Castle Air Force Base, California**

Performed in accordance with:

*Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*, Department of Toxic Substances Control, California Environmental Protection Agency, December 15, 2004

$$\alpha = \frac{C_{\text{indoor}}}{C_{\text{soil gas}}}$$

where:  $\alpha$  = attenuation factor

$C_{\text{indoor}}$  = indoor air concentration ( $\mu\text{g}/\text{m}^3$ )

$C_{\text{soil gas}}$  = soil gas concentration ( $\mu\text{g}/\text{m}^3$ )

For future residential building with slab-on-grade,  $\alpha = 0.0009$

Maximum residual soil gas concentration at DA-4 =  $3.8\text{E+04 } \mu\text{g}/\text{m}^3$

Resultant  $C_{\text{indoor}} = 34.2 \mu\text{g}/\text{m}^3$

$$\text{Excess cancer risk} = \frac{C_{\text{building}} \times \text{EFD} \times \text{URF}}{\text{AT}_c \times 365 \text{ days}}$$

where:  $C_{\text{building}}$  = indoor air concentration ( $\mu\text{g}/\text{m}^3$ )

EFD = exposure frequency and duration (days)

URF = unit risk factor ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>

$\text{AT}_c$  = averaging time for carcinogens (days per year)

$$\begin{aligned} \text{Excess cancer risk} &= \frac{34.2 \mu\text{g}/\text{m}^3 \times (350 \text{ days per year} \times 30 \text{ years}) \times 2\text{E-06} (\mu\text{g}/\text{m}^3)^{-1}}{70 \text{ years} \times 365 \text{ days per year}} \\ &= 2.8\text{E-05} \end{aligned}$$

**J&E MODEL SPREADSHEETS**

**SG-SCREEN**  
Version 2.0; 04/03

Reset to  
Defaults

DATA ENTRY SHEET

**DTSC / HERD**

Version 2.0-mod3; 11/1/03  
Default for Coarse Soil

| ENTER                                               |  | Soil Gas Concentration Data                                    |  | ENTER                                          |  |
|-----------------------------------------------------|--|----------------------------------------------------------------|--|------------------------------------------------|--|
| Chemical<br>CAS No.<br>(numbers only,<br>no dashes) |  | Soil<br>gas<br>conc.,<br>$C_q$<br>( $\mu\text{g}/\text{m}^3$ ) |  | Soil<br>gas<br>conc.,<br>$C_q$<br>(ppmv)       |  |
| <input type="text" value="79016"/>                  |  | <input type="text" value="1.56E+04"/>                          |  | <input type="text" value="Trichloroethylene"/> |  |

| ENTER                                                                                       |  | ENTER                                                          |  | ENTER                                            |  |
|---------------------------------------------------------------------------------------------|--|----------------------------------------------------------------|--|--------------------------------------------------|--|
| Depth<br>below grade<br>to bottom<br>of enclosed<br>space floor,<br>$L_f$<br>(15 or 200 cm) |  | Soil gas<br>sampling<br>depth<br>below grade,<br>$L_s$<br>(cm) |  | Average<br>soil<br>temperature,<br>$T_s$<br>(°C) |  |
| <input type="text" value="15"/>                                                             |  | <input type="text" value="1983"/>                              |  | <input type="text" value="17.8"/>                |  |

| ENTER                                                        |  | ENTER                                                                               |  | ENTER                                                |  |
|--------------------------------------------------------------|--|-------------------------------------------------------------------------------------|--|------------------------------------------------------|--|
| Vadose zone<br>SCS<br>soil type<br>Lookup Soil<br>Parameters |  | Vadose zone<br>soil total<br>bulk density,<br>$P_b^A$<br>( $\text{g}/\text{cm}^3$ ) |  | Vadose zone<br>soil porosity,<br>$n^V$<br>(unitless) |  |
| <input type="text"/>                                         |  | <input type="text"/>                                                                |  | <input type="text"/>                                 |  |

| ENTER                                                    |  | ENTER                                 |  | ENTER                                |  |
|----------------------------------------------------------|--|---------------------------------------|--|--------------------------------------|--|
| Averaging<br>time for<br>carcinogens,<br>$AT_c$<br>(yrs) |  | noncarcinogens,<br>$AT_{nc}$<br>(yrs) |  | Exposure<br>duration,<br>ED<br>(yrs) |  |
| <input type="text" value="70"/>                          |  | <input type="text" value="30"/>       |  | <input type="text" value="30"/>      |  |

**END**

| ENTER                                                                                              |  | ENTER                |  | ENTER                                                                                                      |  |
|----------------------------------------------------------------------------------------------------|--|----------------------|--|------------------------------------------------------------------------------------------------------------|--|
| User-defined<br>vadose zone<br>soil vapor<br>permeability,<br>$k_v$<br>( $\text{cm}^3/\text{hr}$ ) |  | OR                   |  | Average vapor<br>flow rate into bid<br>(leave blank to calculate)<br>$Q_{soil}$<br>( $\text{L}/\text{m}$ ) |  |
| <input type="text"/>                                                                               |  | <input type="text"/> |  | <input type="text" value="1.00E-09"/>                                                                      |  |

## CHEMICAL PROPERTIES SHEET

| Diffusivity<br>in air,<br>$D_a$<br>( $\text{cm}^2/\text{s}$ ) | Diffusivity<br>in water,<br>$D_w$<br>( $\text{cm}^2/\text{s}$ ) | Henry's<br>law constant<br>at reference<br>temperature,<br>$H$<br>( $\text{atm}\cdot\text{m}^3/\text{mol}$ ) | Henry's<br>law constant<br>at reference<br>temperature,<br>$T_R$<br>( $^\circ\text{C}$ ) | Enthalpy of<br>vaporization at<br>the normal<br>boiling point,<br>$\Delta H_{v,b}$<br>(cal/mol) | Normal<br>boiling<br>point,<br>$T_b$<br>( $^\circ\text{K}$ ) | Critical<br>temperature,<br>$T_c$<br>( $^\circ\text{K}$ ) | Unit<br>risk<br>factor,<br>URF | Reference<br>conc.,<br>RFc | Molecular<br>weight,<br>MW<br>(g/mol) |
|---------------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------|--------------------------------|----------------------------|---------------------------------------|
| 7.90E-02                                                      | 9.10E-06                                                        | 1.03E-02                                                                                                     | 25                                                                                       | 7.505                                                                                           | 380.36                                                       | 544.20                                                    | 2.0E-06                        | 6.0E-01                    | 131.39                                |

**END**

## INTERMEDIATE CALCULATIONS SHEET

| Source-building separation, $L_T$ (cm)                      | Vadose zone soil air-filled porosity, $\theta_a^V$ ( $\text{cm}^3/\text{cm}^3$ ) | Vadose zone effective total fluid saturation, $S_{te}$ ( $\text{cm}^3/\text{cm}^3$ ) | Vadose zone soil intrinsic permeability, $k_i$ ( $\text{cm}^2$ )               | Vadose zone soil relative air permeability, $k_{eq}$ ( $\text{cm}^2$ )            | Vadose zone soil effective vapor permeability, $k_v$ ( $\text{cm}^2$ ) | Vadose zone soil effective vapor permeability, $k_v$ ( $\text{cm}^2$ )               | Floor-wall seam perimeter, $X_{crack}$ (cm)                                          | Soil gas conc. ( $\mu\text{g}/\text{m}^3$ )                               | Bldg. ventilation rate, $Q_{building}$ ( $\text{cm}^3/\text{s}$ ) |
|-------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1958                                                        | 0.284                                                                            | #N/A                                                                                 | #N/A                                                                           | #N/A                                                                              | #N/A                                                                   | 1.00E-09                                                                             | 4,000                                                                                | 1.56E-04                                                                  | 3.39E-04                                                          |
| Area of enclosed space below grade, $A_B$ ( $\text{cm}^2$ ) | Crack-to-total area ratio, $\eta$ (unitless)                                     | Crack depth below grade, $Z_{crack}$ (cm)                                            | Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,ts}$ (cal/mol) | Henry's law constant at ave. soil temperature, $H_{ts}$ (atm-m <sup>3</sup> /mol) | Henry's law constant at ave. soil temperature, $H_{ts}$ (unitless)     | Vapor viscosity at ave. soil temperature, $\mu_{ts}$ ( $\mu\text{Pa}\cdot\text{s}$ ) | Vapor viscosity at ave. soil temperature, $\mu_{ts}$ ( $\mu\text{Pa}\cdot\text{s}$ ) | Diffusion coefficient, $D_{eff,v}$ ( $\text{cm}^2/\text{s}$ )             | Diffusion path length, $L_d$ (cm)                                 |
| 1.00E+06                                                    | 5.00E-03                                                                         | 15                                                                                   | 8,460                                                                          | 7.22E-03                                                                          | 3.02E-01                                                               | 1.78E-04                                                                             | 5.90E-03                                                                             | 1968                                                                      |                                                                   |
| Convection path length, $L_p$ (cm)                          | Source vapor conc., $C_{source}$ ( $\mu\text{g}/\text{m}^3$ )                    | Crack radius, $r_{crack}$ (cm)                                                       | Average vapor flow rate into bldg., $Q_{soil}$ ( $\text{cm}^3/\text{s}$ )      | Crack effective diffusion coefficient, $D_{crack}$ ( $\text{cm}^2/\text{s}$ )     | Area of crack, $A_{crack}$ (cm <sup>2</sup> )                          | Peclet number, $\exp(Fe)$ (unitless)                                                 | Exponent of equivalent foundation attenuation coefficient, $\alpha$ (unitless)       | Infinite source indoor conc., $C_{building}$ ( $\mu\text{g}/\text{m}^3$ ) |                                                                   |
| 15                                                          | 1.56E+04                                                                         | 1.25                                                                                 | 1.78E+00                                                                       | 5.90E-03                                                                          | 5.00E+03                                                               | 1.83E+00                                                                             | 5.02E-05                                                                             | 7.83E-01                                                                  |                                                                   |

| Unit risk factor, URF ( $(\mu\text{g}/\text{m}^3)^{-1}$ ) | Reference conc., RIC ( $\text{mg}/\text{m}^3$ ) |
|-----------------------------------------------------------|-------------------------------------------------|
| 2.0E-06                                                   | 6.0E-01                                         |

**END**

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

| Incremental<br>risk from<br>vapor<br>intrusion to<br>indoor air,<br>carcinogen<br>(unitless) | Hazard<br>quotient<br>from vapor<br>intrusion to<br>indoor air,<br>noncarcinogen<br>(unitless) |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| <u>6.4E-07</u>                                                                               | <u>1.3E-03</u>                                                                                 |

MESSAGE SUMMARY BELOW:

**END**

**SG-SCREEN**  
Version 2.0; 0/03

**Reset to  
Defaults**

DATA ENTRY SHEET

**DTSC / HERD**  
Version 2.0-mod3; 11/1/03  
Default for Coarse Soil

| ENTER                                                        |  | Soil Gas Concentration Data                                             |    |                                                   |
|--------------------------------------------------------------|--|-------------------------------------------------------------------------|----|---------------------------------------------------|
| ENTER<br>Chemical<br>CAS No.<br>(numbers only,<br>no dashes) |  | ENTER<br>Soil<br>gas<br>conc.,<br>$C_q$<br>( $\mu\text{g}/\text{m}^3$ ) | OR | ENTER<br>Soil<br>gas<br>conc.,<br>$C_q$<br>(ppmv) |
| <input type="text" value="79016"/>                           |  | <input type="text" value="3.80E+04"/>                                   |    | <input type="text" value="Trichloroethylene"/>    |

| ENTER                                                                                                |  | Soil Gas Concentration Data                                             |                                                  |                                                                                              |
|------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------------------------------------------------------|
| ENTER<br>Depth<br>below grade<br>to bottom<br>of enclosed<br>space floor,<br>$L_f$<br>(15 or 200 cm) |  | ENTER<br>Soil gas<br>sampling<br>depth<br>below grade,<br>$L_s$<br>(cm) | Average<br>soil<br>temperature,<br>$T_s$<br>(°C) | ENTER<br>Vadose zone<br>SCS<br>soil type<br>(used to estimate<br>soil vapor<br>permeability) |
| <input type="text" value="15"/>                                                                      |  | <input type="text" value="1983"/>                                       | <input type="text" value="17.8"/>                | <input type="text" value="1.00E-09"/>                                                        |

| ENTER                                                                                                       |  | Soil Gas Concentration Data                                                                   |                                                                        |                                                                                                    |
|-------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| ENTER<br>Vadose zone<br>SCS<br>soil type<br><input type="button" value="Lookup Soil&lt;br/&gt;Parameters"/> |  | ENTER<br>Vadose zone<br>soil dry<br>bulk density,<br>$\rho_b^A$<br>( $\text{g}/\text{cm}^3$ ) | ENTER<br>Vadose zone<br>soil total<br>porosity,<br>$n^V$<br>(unitless) | ENTER<br>Vadose zone<br>soil water-filled<br>porosity,<br>$n_w^V$<br>( $\text{cm}^3/\text{cm}^3$ ) |
| <input type="text" value="1.47"/>                                                                           |  | <input type="text" value="0.45"/>                                                             | <input type="text" value="0.166"/>                                     | <input type="text" value=""/>                                                                      |

| ENTER                                                             |  | Soil Gas Concentration Data                                             |                                                 |                                                      |
|-------------------------------------------------------------------|--|-------------------------------------------------------------------------|-------------------------------------------------|------------------------------------------------------|
| ENTER<br>Averaging<br>time for<br>carcinogens,<br>$AT_c$<br>(yrs) |  | ENTER<br>Averaging<br>time for<br>noncarcinogens,<br>$AT_{NC}$<br>(yrs) | ENTER<br>Exposure<br>duration,<br>$ED$<br>(yrs) | ENTER<br>Exposure<br>frequency,<br>$EF$<br>(days/yr) |
| <input type="text" value="70"/>                                   |  | <input type="text" value="30"/>                                         | <input type="text" value="30"/>                 | <input type="text" value="350"/>                     |

**MORE ↓**  
**END**

| ENTER                                                                                             |  | Soil Gas Concentration Data                                                                       |                                                                                                   |                                                                                                   |
|---------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| ENTER<br>User-defined<br>vadose zone<br>soil vapor<br>permeability,<br>$k_v$<br>( $\text{cm}^2$ ) |  | ENTER<br>User-defined<br>vadose zone<br>soil vapor<br>permeability,<br>$k_v$<br>( $\text{cm}^2$ ) | ENTER<br>User-defined<br>vadose zone<br>soil vapor<br>permeability,<br>$k_v$<br>( $\text{cm}^2$ ) | ENTER<br>User-defined<br>vadose zone<br>soil vapor<br>permeability,<br>$k_v$<br>( $\text{cm}^2$ ) |
| <input type="text" value=""/>                                                                     |  | <input type="text" value=""/>                                                                     | <input type="text" value=""/>                                                                     | <input type="text" value=""/>                                                                     |

## CHEMICAL PROPERTIES SHEET

| Diffusivity in air,<br>$D_a$<br>(cm <sup>2</sup> /s) | Diffusivity in water,<br>$D_w$<br>(cm <sup>2</sup> /s) | Henry's law constant at reference temperature,<br>$H$<br>(atm-m <sup>3</sup> /mol) | Henry's law constant reference temperature,<br>$T_R$<br>(°C) | Enthalpy of vaporization at the normal boiling point,<br>$\Delta H_{v,b}$<br>(cal/mol) | Normal boiling point,<br>$T_b$<br>(°K) | Critical temperature,<br>$T_c$<br>(°K) | Unit risk factor,<br>URF   | Reference conc.,<br>RIC  | Molecular weight,<br>MW |
|------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------|----------------------------|--------------------------|-------------------------|
|                                                      |                                                        |                                                                                    |                                                              |                                                                                        | $(\mu\text{g}/\text{m}^3)^{-1}$        |                                        | $(\mu\text{g}/\text{m}^3)$ | $(\text{mg}/\text{m}^3)$ | $(\text{g}/\text{mol})$ |
| 7.90E-02                                             | 9.10E-06                                               | 1.03E-02                                                                           | 25                                                           | 7.505                                                                                  | 360.36                                 | 544.20                                 | 2.0E-06                    | 6.0E-01                  | 131.39                  |

END

## INTERMEDIATE CALCULATIONS SHEET

| Source-building separation, $L_T$ (cm)                      | Vadose zone soil air-filled porosity, $\theta_a^v$ ( $\text{cm}^3/\text{cm}^3$ ) | Vadose zone effective total fluid saturation, $S_{le}$ ( $\text{cm}^3/\text{cm}^3$ ) | Vadose zone soil intrinsic permeability, $k_i$ ( $\text{cm}^2$ )               | Vadose zone relative air permeability, $k_{eq}$ ( $\text{cm}^2$ )                 | Vadose zone soil effective vapor permeability, $k_v$ ( $\text{cm}^2$ )            | Vadose zone soil effective vapor permeability, $k_v$ ( $\text{cm}^2$ )    | Floor-wall seam perimeter, $X_{crack}$ (cm)                               | Soil gas conc. ( $\mu\text{g}/\text{m}^3$ )                                         | Bldg. ventilation rate, $Q_{building}$ ( $\text{cm}^3/\text{s}$ )        |
|-------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| 1968                                                        | 0.284                                                                            | #N/A                                                                                 | #N/A                                                                           | #N/A                                                                              | 1.00E-09                                                                          | 4,000                                                                     | 3.80E-04                                                                  | 3.39E+04                                                                            |                                                                          |
| Area of enclosed space below grade, $A_b$ ( $\text{cm}^2$ ) | Crack-to-total area ratio, $\eta$ (unitless)                                     | Crack depth below grade, $Z_{crack}$ (cm)                                            | Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,ts}$ (cal/mol) | Henry's law constant at ave. soil temperature, $H_{ts}$ (atm·m <sup>3</sup> /mol) | Henry's law constant at ave. soil temperature, $H_{ts}$ (atm·m <sup>3</sup> /mol) | Vapor viscosity at ave. soil temperature, $\mu_{ts}$ (g/cm·s)             | Vapor viscosity at ave. soil temperature, $\mu_{ts}$ (g/cm·s)             | Vadose zone effective diffusion coefficient, $D_{eff,v}$ ( $\text{cm}^2/\text{s}$ ) | Diffusion path length, $L_d$ (cm)                                        |
| 1.00E+06                                                    | 5.00E-03                                                                         | 15                                                                                   | 8,460                                                                          | 7.22E-03                                                                          | 3.02E-01                                                                          | 1.78E-04                                                                  | 5.90E-03                                                                  | 1968                                                                                |                                                                          |
| Convection path length, $L_p$ (cm)                          | Source vapor conc., $C_{source}$ ( $\mu\text{g}/\text{m}^3$ )                    | Crack radius, $r_{crack}$ (cm)                                                       | Average vapor flow rate into bldg., $Q_{soil}$ ( $\text{cm}^3/\text{s}$ )      | Crack effective diffusion coefficient, $D_{crack}$ ( $\text{cm}^2/\text{s}$ )     | Area of crack, $A_{crack}$ (cm <sup>2</sup> )                                     | Exponent of equivalent foundation pedestal number, $\exp(P_e)$ (unitless) | Exponent of equivalent foundation pedestal number, $\exp(P_e)$ (unitless) | Infinite source indoor attenuation coefficient, $\alpha$ (unitless)                 | Infinite source bldg. conc., $C_{building}$ ( $\mu\text{g}/\text{m}^3$ ) |
| 15                                                          | 3.80E+04                                                                         | 1.25                                                                                 | 1.78E+00                                                                       | 5.90E-03                                                                          | 5.00E+03                                                                          | 1.83E+00                                                                  | 5.02E-05                                                                  | 1.91E+00                                                                            |                                                                          |

| Unit risk factor, URF ( $\mu\text{g}/\text{m}^3\right)^{-1}$ ) | Reference conc., RfC ( $\text{mg}/\text{m}^3$ ) |
|----------------------------------------------------------------|-------------------------------------------------|
| 2.0E-06                                                        | 6.0E-01                                         |

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

| Incremental risk from vapor intrusion to indoor air, carcinogen (unitless) | Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless) |
|----------------------------------------------------------------------------|------------------------------------------------------------------------------|
| <u>1.6E-06</u>                                                             | <u>3.0E-03</u>                                                               |

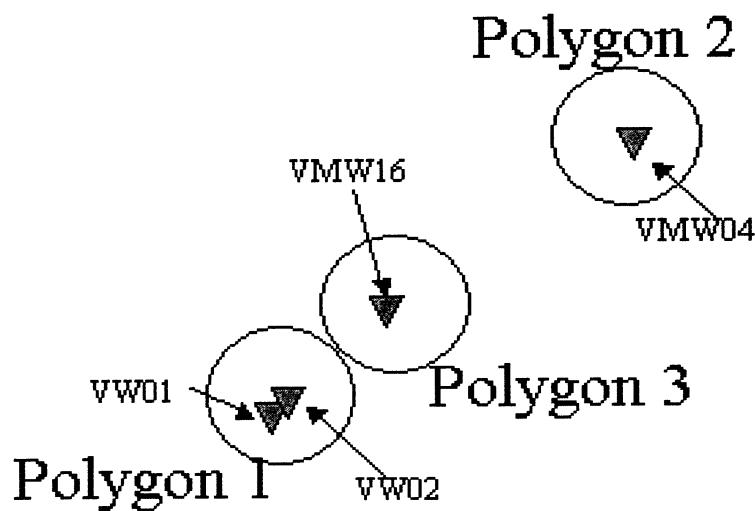
MESSAGE SUMMARY BELOW:

**END**

**APPENDIX E**  
**VLEACH DATA**

### Parameters used for VLEACH

| Simulation at DA-4        | Value  | Unit            | Remarks               |
|---------------------------|--------|-----------------|-----------------------|
| Infiltration Rate         | 0.2842 | ft/yr           |                       |
| Polygon 1 area: VW01/VW02 | 1964   | ft <sup>2</sup> | 50 ft diameter circle |
| Polygon 2 area: VMW04     | 1964   | ft <sup>2</sup> | 50 ft diameter circle |
| Polygon 3 area: VMW16     | 1964   | ft <sup>2</sup> | 50 ft diameter circle |



**Cumulative Mass Flux (Polygons 1, 2, 3)**

| Time | Mass (g/year) | Cumulative Mass (g) | Leachate Conc. |
|------|---------------|---------------------|----------------|
| 1    | 0.83          | 0.83                | 17.43          |
| 2    | 0.81          | 1.63                | 17.03          |
| 3    | 0.79          | 2.42                | 16.64          |
| 4    | 0.77          | 3.19                | 16.26          |
| 5    | 0.75          | 3.95                | 15.87          |
| 6    | 0.73          | 4.68                | 15.49          |
| 7    | 0.72          | 5.40                | 15.11          |
| 8    | 0.70          | 6.10                | 14.73          |
| 9    | 0.68          | 6.78                | 14.36          |
| 10   | 0.66          | 7.44                | 13.98          |
| 11   | 0.65          | 8.09                | 13.60          |
| 12   | 0.63          | 8.71                | 13.23          |
| 13   | 0.61          | 9.32                | 12.86          |
| 14   | 0.59          | 9.92                | 12.49          |
| 15   | 0.57          | 10.49               | 12.12          |
| 16   | 0.56          | 11.05               | 11.75          |
| 17   | 0.54          | 11.59               | 11.39          |
| 18   | 0.52          | 12.11               | 11.03          |
| 19   | 0.51          | 12.62               | 10.67          |
| 20   | 0.49          | 13.11               | 10.32          |
| 21   | 0.47          | 13.58               | 9.97           |
| 22   | 0.46          | 14.03               | 9.62           |
| 23   | 0.44          | 14.47               | 9.28           |
| 24   | 0.42          | 14.90               | 8.94           |
| 25   | 0.41          | 15.31               | 8.61           |
| 26   | 0.39          | 15.70               | 8.29           |
| 27   | 0.38          | 16.08               | 7.97           |
| 28   | 0.36          | 16.44               | 7.65           |
| 29   | 0.35          | 16.79               | 7.34           |
| 30   | 0.33          | 17.12               | 7.04           |
| 31   | 0.32          | 17.44               | 6.75           |
| 32   | 0.31          | 17.75               | 6.46           |
| 33   | 0.29          | 18.04               | 6.18           |
| 34   | 0.28          | 18.32               | 5.91           |
| 35   | 0.27          | 18.59               | 5.65           |
| 36   | 0.26          | 18.85               | 5.39           |
| 37   | 0.24          | 19.09               | 5.14           |
| 38   | 0.23          | 19.32               | 4.90           |
| 39   | 0.22          | 19.54               | 4.67           |
| 40   | 0.21          | 19.75               | 4.44           |
| 41   | 0.20          | 19.95               | 4.22           |
| 42   | 0.19          | 20.14               | 4.02           |
| 43   | 0.18          | 20.33               | 3.81           |
| 44   | 0.17          | 20.50               | 3.62           |
| 45   | 0.16          | 20.66               | 3.44           |
| 46   | 0.15          | 20.81               | 3.26           |
| 47   | 0.15          | 20.96               | 3.09           |
| 48   | 0.14          | 21.10               | 2.93           |
| 49   | 0.13          | 21.23               | 2.77           |
| 50   | 0.12          | 21.36               | 2.62           |

|    |      |       |      |
|----|------|-------|------|
| 51 | 0.12 | 21.47 | 2.48 |
| 52 | 0.11 | 21.58 | 2.34 |
| 53 | 0.11 | 21.69 | 2.22 |
| 54 | 0.10 | 21.79 | 2.09 |
| 55 | 0.09 | 21.88 | 1.98 |
| 56 | 0.09 | 21.97 | 1.87 |
| 57 | 0.08 | 22.05 | 1.76 |
| 58 | 0.08 | 22.13 | 1.66 |
| 59 | 0.07 | 22.21 | 1.56 |
| 60 | 0.07 | 22.28 | 1.47 |

| Time | Mas Flux Polygon 1     |               |                |
|------|------------------------|---------------|----------------|
|      | Mass Flux(g/yr/sq.ft.) | Mass (g/year) | Leachate Conc. |
| 1    | 9.88E-05               | 0.194         | 12.27          |
| 2    | 1.01E-04               | 0.19859       | 12.56          |
| 3    | 1.03E-04               | 0.20241       | 12.80          |
| 4    | 1.05E-04               | 0.2055        | 13.00          |
| 5    | 1.06E-04               | 0.20789       | 13.15          |
| 6    | 1.07E-04               | 0.20962       | 13.26          |
| 7    | 1.07E-04               | 0.21072       | 13.33          |
| 8    | 1.08E-04               | 0.21122       | 13.36          |
| 9    | 1.08E-04               | 0.21117       | 13.36          |
| 10   | 1.07E-04               | 0.2106        | 13.32          |
| 11   | 1.07E-04               | 0.20955       | 13.26          |
| 12   | 1.06E-04               | 0.20804       | 13.16          |
| 13   | 1.05E-04               | 0.20612       | 13.04          |
| 14   | 1.04E-04               | 0.20383       | 12.89          |
| 15   | 1.02E-04               | 0.20118       | 12.73          |
| 16   | 1.01E-04               | 0.19822       | 12.54          |
| 17   | 9.93E-05               | 0.19498       | 12.33          |
| 18   | 9.75E-05               | 0.19149       | 12.11          |
| 19   | 9.56E-05               | 0.18777       | 11.88          |
| 20   | 9.36E-05               | 0.18386       | 11.63          |
| 21   | 9.15E-05               | 0.17977       | 11.37          |
| 22   | 8.94E-05               | 0.17555       | 11.11          |
| 23   | 8.72E-05               | 0.1712        | 10.83          |
| 24   | 8.49E-05               | 0.16675       | 10.55          |
| 25   | 8.26E-05               | 0.16222       | 10.26          |
| 26   | 8.03E-05               | 0.15764       | 9.97           |
| 27   | 7.79E-05               | 0.15301       | 9.68           |
| 28   | 7.55E-05               | 0.14836       | 9.39           |
| 29   | 7.32E-05               | 0.1437        | 9.09           |
| 30   | 7.08E-05               | 0.13904       | 8.80           |
| 31   | 6.84E-05               | 0.13441       | 8.50           |
| 32   | 6.61E-05               | 0.12981       | 8.21           |
| 33   | 6.38E-05               | 0.12525       | 7.92           |
| 34   | 6.15E-05               | 0.12074       | 7.64           |
| 35   | 5.92E-05               | 0.11629       | 7.36           |
| 36   | 5.70E-05               | 0.11191       | 7.08           |
| 37   | 5.48E-05               | 0.10761       | 6.81           |
| 38   | 5.26E-05               | 0.10339       | 6.54           |
| 39   | 5.05E-05               | 9.93E-02      | 6.28           |
| 40   | 4.85E-05               | 9.52E-02      | 6.02           |
| 41   | 4.65E-05               | 9.13E-02      | 5.77           |
| 42   | 4.45E-05               | 8.74E-02      | 5.53           |
| 43   | 4.26E-05               | 8.37E-02      | 5.29           |
| 44   | 4.08E-05               | 8.01E-02      | 5.06           |
| 45   | 3.90E-05               | 7.65E-02      | 4.84           |
| 46   | 3.72E-05               | 7.31E-02      | 4.62           |
| 47   | 3.55E-05               | 6.98E-02      | 4.42           |
| 48   | 3.39E-05               | 6.66E-02      | 4.21           |
| 49   | 3.23E-05               | 6.35E-02      | 4.02           |
| 50   | 3.08E-05               | 6.05E-02      | 3.83           |

|    |          |          |      |
|----|----------|----------|------|
| 51 | 2.93E-05 | 5.76E-02 | 3.64 |
| 52 | 2.79E-05 | 5.48E-02 | 3.47 |
| 53 | 2.66E-05 | 5.22E-02 | 3.30 |
| 54 | 2.52E-05 | 4.96E-02 | 3.14 |
| 55 | 2.40E-05 | 4.71E-02 | 2.98 |
| 56 | 2.28E-05 | 4.47E-02 | 2.83 |
| 57 | 2.16E-05 | 4.25E-02 | 2.69 |
| 58 | 2.05E-05 | 4.03E-02 | 2.55 |
| 59 | 1.94E-05 | 3.82E-02 | 2.42 |
| 60 | 1.84E-05 | 3.62E-02 | 2.29 |

### Mass Flux Polygon 2

| Time | Mass Flux(g/yr/sq.ft.) | Mass (g/year) | Leachate Conc. |
|------|------------------------|---------------|----------------|
| 1    | 2.41E-04               | 0.47379       | 29.97          |
| 2    | 2.39E-04               | 0.46877       | 29.66          |
| 3    | 2.36E-04               | 0.46293       | 29.29          |
| 4    | 2.32E-04               | 0.45633       | 28.87          |
| 5    | 2.29E-04               | 0.44902       | 28.41          |
| 6    | 2.25E-04               | 0.44107       | 27.90          |
| 7    | 2.20E-04               | 0.43254       | 27.36          |
| 8    | 2.16E-04               | 0.42348       | 26.79          |
| 9    | 2.11E-04               | 0.41397       | 26.19          |
| 10   | 2.06E-04               | 0.40407       | 25.56          |
| 11   | 2.01E-04               | 0.39382       | 24.91          |
| 12   | 1.95E-04               | 0.3833        | 24.25          |
| 13   | 1.90E-04               | 0.37256       | 23.57          |
| 14   | 1.84E-04               | 0.36164       | 22.88          |
| 15   | 1.79E-04               | 0.35059       | 22.18          |
| 16   | 1.73E-04               | 0.33946       | 21.47          |
| 17   | 1.67E-04               | 0.32829       | 20.77          |
| 18   | 1.61E-04               | 0.31712       | 20.06          |
| 19   | 1.56E-04               | 0.30598       | 19.36          |
| 20   | 1.50E-04               | 0.2949        | 18.66          |
| 21   | 1.45E-04               | 0.28391       | 17.96          |
| 22   | 1.39E-04               | 0.27304       | 17.27          |
| 23   | 1.34E-04               | 0.26231       | 16.59          |
| 24   | 1.28E-04               | 0.25174       | 15.93          |
| 25   | 1.23E-04               | 0.24134       | 15.27          |
| 26   | 1.18E-04               | 0.23115       | 14.62          |
| 27   | 1.13E-04               | 0.22117       | 13.99          |
| 28   | 1.08E-04               | 0.21141       | 13.37          |
| 29   | 1.03E-04               | 0.20188       | 12.77          |
| 30   | 9.81E-05               | 0.19261       | 12.18          |
| 31   | 9.35E-05               | 0.18358       | 11.61          |
| 32   | 8.90E-05               | 0.17482       | 11.06          |
| 33   | 8.47E-05               | 0.16633       | 10.52          |
| 34   | 8.05E-05               | 0.15811       | 10.00          |
| 35   | 7.65E-05               | 0.15017       | 9.50           |
| 36   | 7.26E-05               | 0.1425        | 9.01           |
| 37   | 6.88E-05               | 0.13512       | 8.55           |
| 38   | 6.52E-05               | 0.12802       | 8.10           |
| 39   | 6.17E-05               | 0.12119       | 7.67           |
| 40   | 5.84E-05               | 0.11464       | 7.25           |
| 41   | 5.52E-05               | 0.10837       | 6.86           |
| 42   | 5.21E-05               | 0.10237       | 6.48           |
| 43   | 4.92E-05               | 9.66E-02      | 6.11           |
| 44   | 4.64E-05               | 9.12E-02      | 5.77           |
| 45   | 4.38E-05               | 8.59E-02      | 5.44           |
| 46   | 4.12E-05               | 8.10E-02      | 5.12           |
| 47   | 3.88E-05               | 7.63E-02      | 4.82           |
| 48   | 3.65E-05               | 7.18E-02      | 4.54           |
| 49   | 3.44E-05               | 6.75E-02      | 4.27           |
| 50   | 3.23E-05               | 6.35E-02      | 4.02           |

|    |          |          |      |
|----|----------|----------|------|
| 51 | 3.04E-05 | 5.97E-02 | 3.77 |
| 52 | 2.85E-05 | 5.60E-02 | 3.55 |
| 53 | 2.68E-05 | 5.26E-02 | 3.33 |
| 54 | 2.52E-05 | 4.94E-02 | 3.13 |
| 55 | 2.36E-05 | 4.64E-02 | 2.93 |
| 56 | 2.21E-05 | 4.35E-02 | 2.75 |
| 57 | 2.08E-05 | 4.08E-02 | 2.58 |
| 58 | 1.95E-05 | 3.82E-02 | 2.42 |
| 59 | 1.82E-05 | 3.58E-02 | 2.27 |
| 60 | 1.71E-05 | 3.36E-02 | 2.12 |

### Mass Flux Polygon 3

| Time | Mass Flux(g/yr/sq.ft.) | Mass (g/year) | Leachate Conc. |
|------|------------------------|---------------|----------------|
| 1    | 8.09E-05               | 0.15884       | 10.05          |
| 2    | 7.15E-05               | 0.14041       | 8.88           |
| 3    | 6.31E-05               | 0.12389       | 7.84           |
| 4    | 5.55E-05               | 0.1091        | 6.90           |
| 5    | 4.88E-05               | 9.59E-02      | 6.06           |
| 6    | 4.28E-05               | 8.40E-02      | 5.31           |
| 7    | 3.74E-05               | 7.34E-02      | 4.65           |
| 8    | 3.26E-05               | 6.40E-02      | 4.05           |
| 9    | 2.84E-05               | 5.57E-02      | 3.52           |
| 10   | 2.46E-05               | 4.83E-02      | 3.06           |
| 11   | 2.13E-05               | 4.18E-02      | 2.64           |
| 12   | 1.84E-05               | 3.60E-02      | 2.28           |
| 13   | 1.58E-05               | 3.10E-02      | 1.96           |
| 14   | 1.36E-05               | 2.67E-02      | 1.69           |
| 15   | 1.16E-05               | 2.29E-02      | 1.45           |
| 16   | 9.97E-06               | 1.96E-02      | 1.24           |
| 17   | 8.52E-06               | 1.67E-02      | 1.06           |
| 18   | 7.28E-06               | 1.43E-02      | 0.90           |
| 19   | 6.21E-06               | 1.22E-02      | 0.77           |
| 20   | 5.30E-06               | 1.04E-02      | 0.66           |
| 21   | 4.53E-06               | 8.90E-03      | 0.56           |
| 22   | 3.87E-06               | 7.60E-03      | 0.48           |
| 23   | 3.31E-06               | 6.50E-03      | 0.41           |
| 24   | 2.84E-06               | 5.57E-03      | 0.35           |
| 25   | 2.43E-06               | 4.78E-03      | 0.30           |
| 26   | 2.10E-06               | 4.12E-03      | 0.26           |
| 27   | 1.81E-06               | 3.55E-03      | 0.22           |
| 28   | 1.57E-06               | 3.08E-03      | 0.19           |
| 29   | 1.36E-06               | 2.67E-03      | 0.17           |
| 30   | 1.19E-06               | 2.33E-03      | 0.15           |
| 31   | 1.04E-06               | 2.04E-03      | 0.13           |
| 32   | 9.15E-07               | 1.80E-03      | 0.11           |
| 33   | 8.09E-07               | 1.59E-03      | 0.10           |
| 34   | 7.18E-07               | 1.41E-03      | 0.09           |
| 35   | 6.40E-07               | 1.26E-03      | 0.08           |
| 36   | 5.73E-07               | 1.13E-03      | 0.07           |
| 37   | 5.15E-07               | 1.01E-03      | 0.06           |
| 38   | 4.65E-07               | 9.13E-04      | 0.06           |
| 39   | 4.21E-07               | 8.27E-04      | 0.05           |
| 40   | 3.83E-07               | 7.51E-04      | 0.05           |
| 41   | 3.49E-07               | 6.85E-04      | 0.04           |
| 42   | 3.19E-07               | 6.26E-04      | 0.04           |
| 43   | 2.92E-07               | 5.74E-04      | 0.04           |
| 44   | 2.69E-07               | 5.28E-04      | 0.03           |
| 45   | 2.47E-07               | 4.86E-04      | 0.03           |
| 46   | 2.28E-07               | 4.48E-04      | 0.03           |
| 47   | 2.11E-07               | 4.14E-04      | 0.03           |
| 48   | 1.95E-07               | 3.83E-04      | 0.02           |
| 49   | 1.81E-07               | 3.55E-04      | 0.02           |
| 50   | 1.68E-07               | 3.30E-04      | 0.02           |

|    |          |          |      |
|----|----------|----------|------|
| 51 | 1.56E-07 | 3.06E-04 | 0.02 |
| 52 | 1.45E-07 | 2.85E-04 | 0.02 |
| 53 | 1.35E-07 | 2.65E-04 | 0.02 |
| 54 | 1.26E-07 | 2.47E-04 | 0.02 |
| 55 | 1.17E-07 | 2.30E-04 | 0.01 |
| 56 | 1.09E-07 | 2.14E-04 | 0.01 |
| 57 | 1.02E-07 | 2.00E-04 | 0.01 |
| 58 | 9.49E-08 | 1.86E-04 | 0.01 |
| 59 | 8.86E-08 | 1.74E-04 | 0.01 |
| 60 | 8.27E-08 | 1.62E-04 | 0.01 |

**APPENDIX F**  
**GROUNDWATER MODELING RESULTS**



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Transmittal #12-074

### CASTLE AIRPORT TRANSMITTAL

|              |                                                                                                                      |                                                                                                                                                                                                                                                                                                           |
|--------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>To:</b>   | Mr. Stanley Pehl<br>HQ AFCEE/BCW<br>3300 Sidney Brooks<br>Brooks City-Base, TX 78235-5112                            | <b>Date:</b> 27 October 2005<br><b>Contract No.:</b> F41624-03-D-8605<br><b>T.O. No.:</b> 0012<br><b>Air Force Project No.:</b> DESR 2005-0712<br><b>Jacobs Project No.:</b> 05-BC12-F1<br><b>Project Name:</b> Comprehensive Basewide Groundwater Remedial Action Operation at the Former Castle AFB, CA |
| <b>From:</b> | <br>Nick Sjaarda<br>Project Manager |                                                                                                                                                                                                                                                                                                           |

| CDRL # | VERSION | DESCRIPTION OF DELIVERABLE                                                                                | DATE SUBMITTED |
|--------|---------|-----------------------------------------------------------------------------------------------------------|----------------|
| A001F  | Final   | Project Note #12-005, Discharge Area 4 VLEACH Transport Simulation Results, Castle Airport Basewide Model | 10-27-05       |

#### REMARKS:

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**JACOBS**

Date: 27 October 2005

**Castle Airport, Project Note #12-005**

Project Number: 05BC12F1

Contract Number: F41624-03-D-8605-0012

Project Name: Remedial Action  
Operation Program

Project Manager: Nick Sjaarda

**Subject:** Discharge Area 4 VLEACH Transport Simulation Results, Castle Airport Basewide Model

---

## 1 INTRODUCTION

This project note summarizes results of simulations performed using the Castle Airport 2003 basewide groundwater flow and transport model (model) to estimate impacts to the existing groundwater contaminant plume of continued leaching of trichloroethene (TCE) through the vadose zone beneath and near Discharge Area 4 (DA-4). Modeling was conducted using Groundwater Vistas (G WV) (ESI, 2001) and MODFLOW-SURFACT (HGL, 1996). MODFLOW-SURFACT was used in the coupled flow and transport mode to simulate additional TCE mass loading into the aquifer.

## 2 MODEL SETUP

TCE migration in the vadose zone beneath and near DA-4 and associated mass flux to the groundwater system were estimated by Earth Tech using VLEACH. The VLEACH analysis performed by Earth Tech simulated TCE migration through the vadose zone at three nested vapor well locations (VMW-01/02, VMW-03/04 and VMW-12/16) at DA-4 (Figure 1). VLEACH simulations required the definition of polygons having uniform recharge and hydraulic properties in order to estimate leachate associated with each vapor well. Earth Tech assumed one polygon (50-foot diameter circle; 1,964 square feet) for each vapor well.

VLEACH results were reported as annual mass flux of TCE (grams per year [g/yr]) to groundwater for a period of 60 years for each of the vapor well polygons (Table 1). Influx of leachate containing TCE to the water table was simulated using the model grid cells in which VMW-01/02 (row 78/column 89), VMW-03/04 (row 78/column 90) and VMW-12/16 (row 78/column 89) are located. Inflow into all cells was set at 0.0079 gallons per minute (gpm). This value was calculated to correspond exactly to the recharge rate used in the VLEACH simulations (0.28 feet per year [ft/yr]) and the dimensions of the vapor well polygons (50-foot circle; surface area of 1,964 square feet each).

The VLEACH data were used to calculate the TCE leachate concentrations for the model cells used to represent the TCE migration through the vadose zone near the three nested vapor well locations. The mean annual mass flux (g/yr) predicted by VLEACH for nested

vapor wells VMW-01/02, VMW-03/04 and VMW-12/16 and the volumetric recharge rate were used to develop the time-varying TCE influent concentrations. The inflow rate was held steady at 0.0079 gpm for each model cell. The resulting TCE concentrations (Table 2) reproduce the mass flux estimates provided by VLEACH, given the model cell dimensions.

Two 60-year transport simulations were performed to evaluate impacts to groundwater and the existing TCE plume from continued leaching of TCE beneath and near DA-4. The first simulation (ambient condition) was performed without the addition of TCE in leachate from DA-4. The second simulation (leaching condition) included the addition of TCE in leachate from DA-4. Both simulations used the same initial TCE plume condition and existing pumping stresses (Q2/2005). Because of the observed lack of significant impact, the leaching condition was only simulated for a total of 15 years. Transport parameters used for the simulation are presented in Table 3. The simulation included the effects of advection, dispersion and retardation. Decay was not simulated.

### 3 SIMULATION RESULTS

Simulation results indicate that groundwater beneath and near DA-4 will not be significantly impacted due to continued leaching of TCE from residual sources in the vadose zone in excess of what is predicted to occur with continued downgradient migration of the current TCE plume. Figures 2, 3 and 4 and Tables 4a, 4b and 4c present model-predicted TCE concentrations in groundwater at VMW-01/02, VMW-03/04 and VMW-12/16 beneath DA-4 for both ambient (no leachate) and leaching condition simulations.

In the Shallow hydrostratigraphic zone (HSZ) beneath DA-4 under leaching conditions, TCE concentrations do not show any increase from the initial condition (year zero ambient concentration) at any of the three nested vapor well locations. Although the decrease in simulated concentration under leaching conditions is at a slower rate than under ambient conditions, the difference in simulated concentrations at 15 years is minimal (leaching vs. ambient simulated concentrations of 0.20 vs. 0.13 µg/L at VMW-01/02; 0.17 vs. 0.09 µg/L at VMW-03/04; 0.16 vs. 0.09 µg/L at VMW-12/16).

TCE concentrations in the Upper Subshallow (USS) and deeper HSZs are essentially not impacted by continued leaching of TCE from residual sources in the vadose zone beneath DA-4 (maximum difference leaching vs. ambient of 0.01 µg/L at VMW-01/02 location; no difference at VMW-03/04 and VMW-12/16 locations).

## Tables

- Table 1 VLEACH Simulated TCE Mass Flux, Vapor Wells VMW-01/02, VMW-03/04 and VMW-12/16, DA-4 Site
- Table 2 Annual TCE Mass Flux and Injection Well Leachate Concentrations, DA-4 Site
- Table 3 TCE Transport Parameters
- Table 4a Simulated Groundwater TCE Concentrations for Vapor Well VMW-01/02, Ambient and Leaching Conditions, DA-4 Site
- Table 4b Simulated Groundwater TCE Concentrations for Vapor Well VMW-03/04, Ambient and Leaching Conditions, DA-4 Site
- Table 4c Simulated Groundwater TCE Concentrations for Vapor Well VMW-12/16, Ambient and Leaching Conditions, DA-4 Site

## Figures

- Figure 1 Vapor Well Locations
- Figure 2 Vapor Well VMW-01/02 Model-Predicted TCE Concentrations in Model Layer 1 – DA-4 Site
- Figure 3 Vapor Well VMW-03/04 Model-Predicted TCE Concentrations in Model Layer 1 – DA-4 Site
- Figure 4 Vapor Well VMW-12/16 Model-Predicted TCE Concentrations in Model Layer 1 – DA-4 Site

## 4 REFERENCES

Environmental Simulations, Inc. (ESI) 2001. *Groundwater Vista<sup>TM</sup>*. Version 3.15. Herndon, Virginia.

HydroGeoLogic, Inc. (HGL). 1996. *Modflow-Surfact*. Version 1.0. Herndon, Virginia.

**Table 1**  
**VLEACH Simulated TCE Mass Flux,**  
**Vapor Wells VMW-01/02, VMW-03/04 and VMW-12/16, DA-4 Site**

| Time<br>(yrs) | VMW-01/02          |                               | VMW-03/04          |                               | VMW-12/16          |                               |
|---------------|--------------------|-------------------------------|--------------------|-------------------------------|--------------------|-------------------------------|
|               | TCE Mass<br>(g/yr) | Cumulative<br>TCE Mass<br>(g) | TCE Mass<br>(g/yr) | Cumulative<br>TCE Mass<br>(g) | TCE Mass<br>(g/yr) | Cumulative<br>TCE Mass<br>(g) |
| 1             | 0.19               | 0.19                          | 0.47               | 0.47                          | 0.16               | 0.16                          |
| 2             | 0.20               | 0.39                          | 0.47               | 0.94                          | 0.14               | 0.30                          |
| 3             | 0.20               | 0.60                          | 0.46               | 1.41                          | 0.12               | 0.42                          |
| 4             | 0.21               | 0.80                          | 0.46               | 1.86                          | 0.11               | 0.53                          |
| 5             | 0.21               | 1.01                          | 0.45               | 2.31                          | 0.10               | 0.63                          |
| 6             | 0.21               | 1.22                          | 0.44               | 2.75                          | 0.08               | 0.71                          |
| 7             | 0.21               | 1.43                          | 0.43               | 3.18                          | 0.07               | 0.79                          |
| 8             | 0.21               | 1.64                          | 0.42               | 3.61                          | 0.06               | 0.85                          |
| 9             | 0.21               | 1.85                          | 0.41               | 4.02                          | 0.06               | 0.91                          |
| 10            | 0.21               | 2.06                          | 0.40               | 4.43                          | 0.05               | 0.95                          |
| 11            | 0.21               | 2.27                          | 0.39               | 4.82                          | 0.04               | 1.00                          |
| 12            | 0.21               | 2.48                          | 0.38               | 5.20                          | 0.04               | 1.03                          |
| 13            | 0.21               | 2.69                          | 0.37               | 5.58                          | 0.03               | 1.06                          |
| 14            | 0.20               | 2.89                          | 0.36               | 5.94                          | 0.03               | 1.09                          |
| 15            | 0.20               | 3.09                          | 0.35               | 6.29                          | 0.02               | 1.11                          |
| 16            | 0.20               | 3.29                          | 0.34               | 6.63                          | 0.02               | 1.13                          |
| 17            | 0.19               | 3.48                          | 0.33               | 6.96                          | 0.02               | 1.15                          |
| 18            | 0.19               | 3.68                          | 0.32               | 7.27                          | 0.01               | 1.16                          |
| 19            | 0.19               | 3.86                          | 0.31               | 7.58                          | 0.01               | 1.17                          |
| 20            | 0.18               | 4.05                          | 0.29               | 7.87                          | 0.01               | 1.19                          |
| 21            | 0.18               | 4.23                          | 0.28               | 8.16                          | 0.01               | 1.19                          |
| 22            | 0.18               | 4.40                          | 0.27               | 8.43                          | 0.01               | 1.20                          |
| 23            | 0.17               | 4.57                          | 0.26               | 8.69                          | 0.01               | 1.21                          |
| 24            | 0.17               | 4.74                          | 0.25               | 8.94                          | 0.01               | 1.21                          |
| 25            | 0.16               | 4.90                          | 0.24               | 9.19                          | 0.00               | 1.22                          |
| 26            | 0.16               | 5.06                          | 0.23               | 9.42                          | 0.00               | 1.22                          |
| 27            | 0.15               | 5.21                          | 0.22               | 9.64                          | 0.00               | 1.23                          |
| 28            | 0.15               | 5.36                          | 0.21               | 9.85                          | 0.00               | 1.23                          |
| 29            | 0.14               | 5.50                          | 0.20               | 10.05                         | 0.00               | 1.23                          |
| 30            | 0.14               | 5.64                          | 0.19               | 10.24                         | 0.00               | 1.23                          |
| 31            | 0.13               | 5.78                          | 0.18               | 10.43                         | 0.00               | 1.24                          |
| 32            | 0.13               | 5.91                          | 0.17               | 10.60                         | 0.00               | 1.24                          |
| 33            | 0.13               | 6.03                          | 0.17               | 10.77                         | 0.00               | 1.24                          |
| 34            | 0.12               | 6.15                          | 0.16               | 10.93                         | 0.00               | 1.24                          |
| 35            | 0.12               | 6.27                          | 0.15               | 11.08                         | 0.00               | 1.24                          |
| 36            | 0.11               | 6.38                          | 0.14               | 11.22                         | 0.00               | 1.24                          |
| 37            | 0.11               | 6.49                          | 0.14               | 11.35                         | 0.00               | 1.24                          |
| 38            | 0.10               | 6.59                          | 0.13               | 11.48                         | 0.00               | 1.25                          |
| 39            | 0.10               | 6.69                          | 0.12               | 11.60                         | 0.00               | 1.25                          |
| 40            | 0.10               | 6.79                          | 0.11               | 11.72                         | 0.00               | 1.25                          |
| 41            | 0.09               | 6.88                          | 0.11               | 11.83                         | 0.00               | 1.25                          |
| 42            | 0.09               | 6.97                          | 0.10               | 11.93                         | 0.00               | 1.25                          |
| 43            | 0.08               | 7.05                          | 0.10               | 12.03                         | 0.00               | 1.25                          |
| 44            | 0.08               | 7.13                          | 0.09               | 12.12                         | 0.00               | 1.25                          |
| 45            | 0.08               | 7.21                          | 0.09               | 12.20                         | 0.00               | 1.25                          |
| 46            | 0.07               | 7.28                          | 0.08               | 12.28                         | 0.00               | 1.25                          |
| 47            | 0.07               | 7.35                          | 0.08               | 12.36                         | 0.00               | 1.25                          |

**Table 1**  
**VLEACH Simulated TCE Mass Flux,**  
**Vapor Wells VMW-01/02, VMW-03/04 and VMW-12/16, DA-4 Site**

| Time<br>(yrs) | VMW-01/02          |                               | VMW-03/04          |                               | VMW-12/16          |                               |
|---------------|--------------------|-------------------------------|--------------------|-------------------------------|--------------------|-------------------------------|
|               | TCE Mass<br>(g/yr) | Cumulative<br>TCE Mass<br>(g) | TCE Mass<br>(g/yr) | Cumulative<br>TCE Mass<br>(g) | TCE Mass<br>(g/yr) | Cumulative<br>TCE Mass<br>(g) |
| 48            | 0.07               | 7.42                          | 0.07               | 12.43                         | 0.00               | 1.25                          |
| 49            | 0.06               | 7.48                          | 0.07               | 12.50                         | 0.00               | 1.25                          |
| 50            | 0.06               | 7.54                          | 0.06               | 12.56                         | 0.00               | 1.25                          |
| 51            | 0.06               | 7.60                          | 0.06               | 12.62                         | 0.00               | 1.25                          |
| 52            | 0.05               | 7.65                          | 0.06               | 12.68                         | 0.00               | 1.25                          |
| 53            | 0.05               | 7.70                          | 0.05               | 12.73                         | 0.00               | 1.25                          |
| 54            | 0.05               | 7.75                          | 0.05               | 12.78                         | 0.00               | 1.25                          |
| 55            | 0.05               | 7.80                          | 0.05               | 12.83                         | 0.00               | 1.25                          |
| 56            | 0.04               | 7.85                          | 0.04               | 12.87                         | 0.00               | 1.25                          |
| 57            | 0.04               | 7.89                          | 0.04               | 12.91                         | 0.00               | 1.25                          |
| 58            | 0.04               | 7.93                          | 0.04               | 12.95                         | 0.00               | 1.25                          |
| 59            | 0.04               | 7.97                          | 0.04               | 12.99                         | 0.00               | 1.25                          |
| 60            | 0.04               | 8.00                          | 0.03               | 13.02                         | 0.00               | 1.25                          |

**Notes**

g                    grams  
yr(s)            year(s)

**Table 2**  
**Annual TCE Mass Flux and Injection Well Leachate Concentrations, DA-4 Site**

| Time<br>(yrs) | Vapor Well VMW-01/02                       |                                                  | Vapor Well VMW-03/04                       |                                                  | Vapor Well VMW-12/16                       |                                                  |
|---------------|--------------------------------------------|--------------------------------------------------|--------------------------------------------|--------------------------------------------------|--------------------------------------------|--------------------------------------------------|
|               | 1-year TCE Mass Flux to Groundwater (g/yr) | Injection Well TCE Leachate Concentration (µg/L) | 1-year TCE Mass Flux to Groundwater (g/yr) | Injection Well TCE Leachate Concentration (µg/L) | 1-year TCE Mass Flux to Groundwater (g/yr) | Injection Well TCE Leachate Concentration (µg/L) |
| 0             | 0.000                                      | 0.000                                            | 0.000                                      | 0.000                                            | 0.000                                      | 0.000                                            |
| 1             | 0.19                                       | 12.28                                            | 0.47                                       | 29.98                                            | 0.16                                       | 10.05                                            |
| 2             | 0.20                                       | 12.57                                            | 0.47                                       | 29.66                                            | 0.14                                       | 8.88                                             |
| 3             | 0.20                                       | 12.81                                            | 0.46                                       | 29.29                                            | 0.12                                       | 7.84                                             |
| 4             | 0.21                                       | 13.00                                            | 0.46                                       | 28.88                                            | 0.11                                       | 6.90                                             |
| 5             | 0.21                                       | 13.15                                            | 0.45                                       | 28.41                                            | 0.10                                       | 6.07                                             |
| 6             | 0.21                                       | 13.26                                            | 0.44                                       | 27.91                                            | 0.08                                       | 5.32                                             |
| 7             | 0.21                                       | 13.33                                            | 0.43                                       | 27.37                                            | 0.07                                       | 4.65                                             |
| 8             | 0.21                                       | 13.37                                            | 0.42                                       | 26.80                                            | 0.06                                       | 4.05                                             |
| 9             | 0.21                                       | 13.36                                            | 0.41                                       | 26.20                                            | 0.06                                       | 3.52                                             |
| 10            | 0.21                                       | 13.33                                            | 0.40                                       | 25.57                                            | 0.05                                       | 3.06                                             |
| 11            | 0.21                                       | 13.26                                            | 0.39                                       | 24.92                                            | 0.04                                       | 2.64                                             |
| 12            | 0.21                                       | 13.16                                            | 0.38                                       | 24.25                                            | 0.04                                       | 2.28                                             |
| 13            | 0.21                                       | 13.04                                            | 0.37                                       | 23.57                                            | 0.03                                       | 1.96                                             |
| 14            | 0.20                                       | 12.90                                            | 0.36                                       | 22.88                                            | 0.03                                       | 1.69                                             |
| 15            | 0.20                                       | 12.73                                            | 0.35                                       | 22.18                                            | 0.02                                       | 1.45                                             |
| 16            | 0.20                                       | 12.54                                            | 0.34                                       | 21.48                                            | 0.02                                       | 1.24                                             |
| 17            | 0.19                                       | 12.34                                            | 0.33                                       | 20.77                                            | 0.02                                       | 1.06                                             |
| 18            | 0.19                                       | 12.12                                            | 0.32                                       | 20.07                                            | 0.01                                       | 0.90                                             |
| 19            | 0.19                                       | 11.88                                            | 0.31                                       | 19.36                                            | 0.01                                       | 0.77                                             |
| 20            | 0.18                                       | 11.63                                            | 0.29                                       | 18.66                                            | 0.01                                       | 0.66                                             |
| 21            | 0.18                                       | 11.38                                            | 0.28                                       | 17.97                                            | 0.01                                       | 0.56                                             |
| 22            | 0.18                                       | 11.11                                            | 0.27                                       | 17.28                                            | 0.01                                       | 0.48                                             |
| 23            | 0.17                                       | 10.83                                            | 0.26                                       | 16.60                                            | 0.01                                       | 0.41                                             |
| 24            | 0.17                                       | 10.55                                            | 0.25                                       | 15.93                                            | 0.01                                       | 0.35                                             |
| 25            | 0.16                                       | 10.26                                            | 0.24                                       | 15.27                                            | 0.00                                       | 0.30                                             |
| 26            | 0.16                                       | 9.98                                             | 0.23                                       | 14.63                                            | 0.00                                       | 0.26                                             |
| 27            | 0.15                                       | 9.68                                             | 0.22                                       | 14.00                                            | 0.00                                       | 0.22                                             |
| 28            | 0.15                                       | 9.39                                             | 0.21                                       | 13.38                                            | 0.00                                       | 0.19                                             |
| 29            | 0.14                                       | 9.09                                             | 0.20                                       | 12.77                                            | 0.00                                       | 0.17                                             |
| 30            | 0.14                                       | 8.80                                             | 0.19                                       | 12.19                                            | 0.00                                       | 0.15                                             |
| 31            | 0.13                                       | 8.51                                             | 0.18                                       | 11.62                                            | 0.00                                       | 0.13                                             |
| 32            | 0.13                                       | 8.21                                             | 0.17                                       | 11.06                                            | 0.00                                       | 0.11                                             |
| 33            | 0.13                                       | 7.93                                             | 0.17                                       | 10.53                                            | 0.00                                       | 0.10                                             |
| 34            | 0.12                                       | 7.64                                             | 0.16                                       | 10.00                                            | 0.00                                       | 0.09                                             |
| 35            | 0.12                                       | 7.36                                             | 0.15                                       | 9.50                                             | 0.00                                       | 0.08                                             |
| 36            | 0.11                                       | 7.08                                             | 0.14                                       | 9.02                                             | 0.00                                       | 0.07                                             |
| 37            | 0.11                                       | 6.81                                             | 0.14                                       | 8.55                                             | 0.00                                       | 0.06                                             |
| 38            | 0.10                                       | 6.54                                             | 0.13                                       | 8.10                                             | 0.00                                       | 0.06                                             |
| 39            | 0.10                                       | 6.28                                             | 0.12                                       | 7.67                                             | 0.00                                       | 0.05                                             |
| 40            | 0.10                                       | 6.03                                             | 0.11                                       | 7.25                                             | 0.00                                       | 0.05                                             |
| 41            | 0.09                                       | 5.78                                             | 0.11                                       | 6.86                                             | 0.00                                       | 0.04                                             |
| 42            | 0.09                                       | 5.53                                             | 0.10                                       | 6.48                                             | 0.00                                       | 0.04                                             |

**Table 2**  
**Annual TCE Mass Flux and Injection Well Leachate Concentrations, DA-4 Site**

| Time<br>(yrs) | Vapor Well VMW-01/02                       |                                                  | Vapor Well VMW-03/04                       |                                                  | Vapor Well VMW-12/16                       |                                                  |
|---------------|--------------------------------------------|--------------------------------------------------|--------------------------------------------|--------------------------------------------------|--------------------------------------------|--------------------------------------------------|
|               | 1-year TCE Mass Flux to Groundwater (g/yr) | Injection Well TCE Leachate Concentration (µg/L) | 1-year TCE Mass Flux to Groundwater (g/yr) | Injection Well TCE Leachate Concentration (µg/L) | 1-year TCE Mass Flux to Groundwater (g/yr) | Injection Well TCE Leachate Concentration (µg/L) |
| 43            | 0.08                                       | 5.30                                             | 0.10                                       | 6.11                                             | 0.00                                       | 0.04                                             |
| 44            | 0.08                                       | 5.07                                             | 0.09                                       | 5.77                                             | 0.00                                       | 0.03                                             |
| 45            | 0.08                                       | 4.84                                             | 0.09                                       | 5.44                                             | 0.00                                       | 0.03                                             |
| 46            | 0.07                                       | 4.63                                             | 0.08                                       | 5.12                                             | 0.00                                       | 0.03                                             |
| 47            | 0.07                                       | 4.42                                             | 0.08                                       | 4.83                                             | 0.00                                       | 0.03                                             |
| 48            | 0.07                                       | 4.21                                             | 0.07                                       | 4.54                                             | 0.00                                       | 0.02                                             |
| 49            | 0.06                                       | 4.02                                             | 0.07                                       | 4.27                                             | 0.00                                       | 0.02                                             |
| 50            | 0.06                                       | 3.83                                             | 0.06                                       | 4.02                                             | 0.00                                       | 0.02                                             |
| 51            | 0.06                                       | 3.65                                             | 0.06                                       | 3.78                                             | 0.00                                       | 0.02                                             |
| 52            | 0.05                                       | 3.47                                             | 0.06                                       | 3.55                                             | 0.00                                       | 0.02                                             |
| 53            | 0.05                                       | 3.30                                             | 0.05                                       | 3.33                                             | 0.00                                       | 0.02                                             |
| 54            | 0.05                                       | 3.14                                             | 0.05                                       | 3.13                                             | 0.00                                       | 0.02                                             |
| 55            | 0.05                                       | 2.98                                             | 0.05                                       | 2.93                                             | 0.00                                       | 0.01                                             |
| 56            | 0.04                                       | 2.83                                             | 0.04                                       | 2.75                                             | 0.00                                       | 0.01                                             |
| 57            | 0.04                                       | 2.69                                             | 0.04                                       | 2.58                                             | 0.00                                       | 0.01                                             |
| 58            | 0.04                                       | 2.55                                             | 0.04                                       | 2.42                                             | 0.00                                       | 0.01                                             |
| 59            | 0.04                                       | 2.42                                             | 0.04                                       | 2.27                                             | 0.00                                       | 0.01                                             |
| 60            | 0.04                                       | 2.29                                             | 0.03                                       | 2.13                                             | 0.00                                       | 0.01                                             |

**Notes**

µg/L micrograms per liter  
g grams  
yr(s) year(s)

**Table 3**  
**TCE Transport Parameters**

| Matrix-Related Transport Parameters       |                                                    |                      |                |                |                    |                                                      |
|-------------------------------------------|----------------------------------------------------|----------------------|----------------|----------------|--------------------|------------------------------------------------------|
| C2003 Model Layer<br>(HSZ)                | Bulk Density<br>(lb/ft <sup>3</sup> ) <sup>1</sup> | Dispersivity<br>(ft) |                |                | TOC % <sup>2</sup> | Distribution Coefficient<br>(Kd) <sup>3</sup> (mL/g) |
|                                           |                                                    | a <sub>L</sub>       | a <sub>T</sub> | a <sub>V</sub> |                    |                                                      |
| 1 (SH)                                    | 110                                                | 5                    | 0.5            | 0.05           | 0.20               | 0.252                                                |
| 2-7 (USS)                                 | 104-110                                            | 5                    | 0.5            | 0.05           | 0.10               | 0.123                                                |
| 8-15 (LSS)                                | 109-111                                            | 1.9                  | 0.19           | 0.019          | 0.14               | 0.170                                                |
| 16-21 (Upper CF)                          | 102                                                | 1.2                  | 0.12           | 0.012          | 0.12               | 0.151                                                |
| 22-27 (Middle CF)                         | 96                                                 | 2                    | 0.2            | 0.02           | 0.12               | 0.151                                                |
| 28-30 (Lower CF)                          | 91                                                 | 2                    | 0.2            | 0.02           | 0.21               | 0.265                                                |
| 31-56 (Deep)                              | 95                                                 | 2                    | 0.2            | 0.02           | 0.13               | 0.164                                                |
| Contaminant-Specific Transport Parameters |                                                    |                      |                |                |                    |                                                      |
| K <sub>oc</sub> (mL/g)                    |                                                    |                      |                | 126.0          |                    |                                                      |
| Diffusion (m/sec <sup>2</sup> )           |                                                    |                      |                | 3.60E-10       |                    |                                                      |
| Lithology-Specific Transport Parameters   |                                                    |                      |                |                |                    |                                                      |
|                                           | Gravels                                            | Sands                | Silty Sands    | Silts          |                    |                                                      |
| Effective Porosity                        | 0.3                                                | 0.25 - 0.28          | 0.2            | 0.1            |                    |                                                      |

**Notes:**

- <sup>1</sup> Values taken from Castle Airport Long-Term Groundwater Sampling Program (LTGSP) 2000 Annual Report (Jacobs, 2001)
- <sup>2</sup> Values updated for USS, LSS and Upper CF HSZ based on averaging TOC data reported in the Phase 3 Groundwater Treatment System Startup Report (Jacobs, 2000)
- <sup>3</sup> Distribution coefficients for TCE were taken from the LTGSP 2000 Annual Report (Jacobs, 2001). These values were calculated from TOC % data reported in the Phase 3 Groundwater Treatment System Startup Report (Jacobs, 2000) and K<sub>oc</sub> values reported in the TEER (Jacobs, 1999).

TOC reported to range from 0.005 % to 0.3 % for Castle sediments

Horizontal and vertical anisotropy for dispersivity of 0.1 and 0.01 were assumed

|                    |                                           |                    |                           |
|--------------------|-------------------------------------------|--------------------|---------------------------|
| a <sub>L</sub>     | longitudinal dispersivity                 | LSS                | Lower Subshallow HSZ      |
| a <sub>T</sub>     | transverse dispersivity                   | mL/g               | milliliters per gram      |
| a <sub>V</sub>     | vertical dispersivity                     | m/sec <sup>2</sup> | meters per second squared |
| CF                 | Confined HSZ                              | SH                 | Shallow HSZ               |
| diffusion          | effective molecular diffusion coefficient | TCE                | trichloroethene           |
| ft                 | feet                                      | TOC                | total organic carbon      |
| HSZ                | hydrostratigraphic zone                   | USS                | Upper Subshallow HSZ      |
| K <sub>oc</sub>    | organic-carbon partition coefficient      |                    |                           |
| lb/ft <sup>3</sup> | pounds per cubic foot                     |                    |                           |

**Table 4a**  
**Simulated Groundwater TCE Concentrations for Vapor Well VMW-01/02,  
Ambient and Leaching Conditions, DA-4 Site**

| Time<br>(yrs) | Ambient Condition TCE Concentration ( $\mu\text{g/L}$ ) |                      |                      |                      | Leaching Condition TCE Concentration ( $\mu\text{g/L}$ ) |                      |                      |                      |
|---------------|---------------------------------------------------------|----------------------|----------------------|----------------------|----------------------------------------------------------|----------------------|----------------------|----------------------|
|               | Layer 1 <sup>1</sup>                                    | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> | Layer 1 <sup>1</sup>                                     | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> |
| 0             | 0.55                                                    | 0.59                 | 0.58                 | 0.58                 | 0.55                                                     | 0.59                 | 0.58                 | 0.58                 |
| 1             | 0.50                                                    | 0.42                 | 0.48                 | 0.44                 | 0.52                                                     | 0.42                 | 0.48                 | 0.44                 |
| 2             | 0.46                                                    | 0.30                 | 0.40                 | 0.34                 | 0.48                                                     | 0.30                 | 0.40                 | 0.34                 |
| 3             | 0.41                                                    | 0.22                 | 0.32                 | 0.27                 | 0.45                                                     | 0.22                 | 0.32                 | 0.27                 |
| 4             | 0.37                                                    | 0.17                 | 0.26                 | 0.21                 | 0.41                                                     | 0.17                 | 0.26                 | 0.21                 |
| 5             | 0.33                                                    | 0.13                 | 0.21                 | 0.17                 | 0.38                                                     | 0.14                 | 0.21                 | 0.17                 |
| 6             | 0.29                                                    | 0.11                 | 0.17                 | 0.14                 | 0.35                                                     | 0.12                 | 0.18                 | 0.14                 |
| 7             | 0.25                                                    | 0.10                 | 0.14                 | 0.12                 | 0.32                                                     | 0.11                 | 0.15                 | 0.12                 |
| 8             | 0.22                                                    | 0.10                 | 0.12                 | 0.11                 | 0.29                                                     | 0.10                 | 0.13                 | 0.11                 |
| 9             | 0.20                                                    | 0.09                 | 0.11                 | 0.10                 | 0.27                                                     | 0.10                 | 0.11                 | 0.10                 |
| 10            | 0.18                                                    | 0.09                 | 0.10                 | 0.09                 | 0.25                                                     | 0.10                 | 0.10                 | 0.09                 |
| 11            | 0.16                                                    | 0.09                 | 0.09                 | 0.08                 | 0.23                                                     | 0.10                 | 0.09                 | 0.08                 |
| 12            | 0.15                                                    | 0.09                 | 0.09                 | 0.08                 | 0.22                                                     | 0.10                 | 0.09                 | 0.08                 |
| 13            | 0.14                                                    | 0.10                 | 0.08                 | 0.08                 | 0.21                                                     | 0.11                 | 0.09                 | 0.08                 |
| 14            | 0.13                                                    | 0.10                 | 0.08                 | 0.08                 | 0.20                                                     | 0.11                 | 0.09                 | 0.08                 |
| 15            | 0.13                                                    | 0.11                 | 0.08                 | 0.08                 | 0.20                                                     | 0.12                 | 0.09                 | 0.08                 |
| 16            | 0.12                                                    | 0.12                 | 0.09                 | 0.08                 |                                                          |                      |                      |                      |
| 17            | 0.12                                                    | 0.13                 | 0.09                 | 0.08                 |                                                          |                      |                      |                      |
| 18            | 0.11                                                    | 0.14                 | 0.10                 | 0.09                 |                                                          |                      |                      |                      |
| 19            | 0.11                                                    | 0.15                 | 0.10                 | 0.09                 |                                                          |                      |                      |                      |
| 20            | 0.11                                                    | 0.17                 | 0.11                 | 0.10                 |                                                          |                      |                      |                      |
| 21            | 0.11                                                    | 0.18                 | 0.12                 | 0.11                 |                                                          |                      |                      |                      |
| 22            | 0.11                                                    | 0.19                 | 0.12                 | 0.11                 |                                                          |                      |                      |                      |
| 23            | 0.11                                                    | 0.21                 | 0.13                 | 0.12                 |                                                          |                      |                      |                      |
| 24            | 0.11                                                    | 0.22                 | 0.14                 | 0.13                 |                                                          |                      |                      |                      |
| 25            | 0.11                                                    | 0.24                 | 0.16                 | 0.15                 |                                                          |                      |                      |                      |
| 26            | 0.12                                                    | 0.26                 | 0.17                 | 0.16                 |                                                          |                      |                      |                      |
| 27            | 0.12                                                    | 0.28                 | 0.18                 | 0.17                 |                                                          |                      |                      |                      |
| 28            | 0.12                                                    | 0.30                 | 0.19                 | 0.18                 |                                                          |                      |                      |                      |
| 29            | 0.13                                                    | 0.33                 | 0.21                 | 0.20                 |                                                          |                      |                      |                      |
| 30            | 0.13                                                    | 0.35                 | 0.22                 | 0.22                 |                                                          |                      |                      |                      |
| 31            | 0.14                                                    | 0.38                 | 0.24                 | 0.24                 |                                                          |                      |                      |                      |
| 32            | 0.14                                                    | 0.41                 | 0.26                 | 0.26                 |                                                          |                      |                      |                      |
| 33            | 0.15                                                    | 0.45                 | 0.28                 | 0.28                 |                                                          |                      |                      |                      |
| 34            | 0.16                                                    | 0.49                 | 0.31                 | 0.31                 |                                                          |                      |                      |                      |
| 35            | 0.17                                                    | 0.53                 | 0.33                 | 0.33                 |                                                          |                      |                      |                      |
| 36            | 0.18                                                    | 0.57                 | 0.36                 | 0.37                 |                                                          |                      |                      |                      |
| 37            | 0.19                                                    | 0.62                 | 0.39                 | 0.40                 |                                                          |                      |                      |                      |
| 38            | 0.20                                                    | 0.66                 | 0.42                 | 0.44                 |                                                          |                      |                      |                      |
| 39            | 0.21                                                    | 0.71                 | 0.45                 | 0.48                 |                                                          |                      |                      |                      |
| 40            | 0.22                                                    | 0.77                 | 0.49                 | 0.52                 |                                                          |                      |                      |                      |
| 41            | 0.24                                                    | 0.82                 | 0.52                 | 0.57                 |                                                          |                      |                      |                      |
| 42            | 0.25                                                    | 0.87                 | 0.56                 | 0.62                 |                                                          |                      |                      |                      |
| 43            | 0.27                                                    | 0.93                 | 0.60                 | 0.68                 |                                                          |                      |                      |                      |
| 44            | 0.29                                                    | 0.99                 | 0.65                 | 0.74                 |                                                          |                      |                      |                      |
| 45            | 0.30                                                    | 1.04                 | 0.69                 | 0.80                 |                                                          |                      |                      |                      |
| 46            | 0.32                                                    | 1.10                 | 0.74                 | 0.86                 |                                                          |                      |                      |                      |

**Table 4a**  
**Simulated Groundwater TCE Concentrations for Vapor Well VMW-01/02,  
Ambient and Leaching Conditions, DA-4 Site**

| Time<br>(yrs) | Ambient Condition TCE Concentration ( $\mu\text{g/L}$ ) |                      |                      |                      | Leaching Condition TCE Concentration ( $\mu\text{g/L}$ ) |                      |                      |                      |
|---------------|---------------------------------------------------------|----------------------|----------------------|----------------------|----------------------------------------------------------|----------------------|----------------------|----------------------|
|               | Layer 1 <sup>1</sup>                                    | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> | Layer 1 <sup>1</sup>                                     | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> |
| 47            | 0.34                                                    | 1.16                 | 0.79                 | 0.93                 |                                                          |                      |                      |                      |
| 48            | 0.36                                                    | 1.21                 | 0.84                 | 1.00                 |                                                          |                      |                      |                      |
| 49            | 0.38                                                    | 1.27                 | 0.89                 | 1.07                 |                                                          |                      |                      |                      |
| 50            | 0.41                                                    | 1.33                 | 0.94                 | 1.14                 |                                                          |                      |                      |                      |
| 51            | 0.43                                                    | 1.38                 | 0.99                 | 1.21                 |                                                          |                      |                      |                      |
| 52            | 0.46                                                    | 1.43                 | 1.04                 | 1.28                 |                                                          |                      |                      |                      |
| 53            | 0.48                                                    | 1.49                 | 1.09                 | 1.34                 |                                                          |                      |                      |                      |
| 54            | 0.51                                                    | 1.54                 | 1.13                 | 1.41                 |                                                          |                      |                      |                      |
| 55            | 0.54                                                    | 1.59                 | 1.18                 | 1.48                 |                                                          |                      |                      |                      |
| 56            | 0.58                                                    | 1.63                 | 1.23                 | 1.54                 |                                                          |                      |                      |                      |
| 57            | 0.61                                                    | 1.68                 | 1.27                 | 1.60                 |                                                          |                      |                      |                      |
| 58            | 0.65                                                    | 1.72                 | 1.31                 | 1.66                 |                                                          |                      |                      |                      |
| 59            | 0.69                                                    | 1.76                 | 1.35                 | 1.71                 |                                                          |                      |                      |                      |
| 60            | 0.73                                                    | 1.80                 | 1.39                 | 1.76                 |                                                          |                      |                      |                      |

**Notes**

<sup>1</sup> Layer refers to groundwater model layers

Layer 1 = Shallow Hydrostratigraphic Zone (HSZ)

Layers 2-4 = upper portion of the Upper Subshallow HSZ

$\mu\text{g/L}$  micrograms per liter  
yrs years

**Table 4b**  
**Simulated Groundwater TCE Concentrations for Vapor Well VMW-03/04,  
Ambient and Leaching Conditions, DA-4 Site**

| Time<br>(yrs) | Ambient Condition TCE Concentration ( $\mu\text{g/L}$ ) |                      |                      |                      | Leaching Condition TCE Concentration ( $\mu\text{g/L}$ ) |                      |                      |                      |
|---------------|---------------------------------------------------------|----------------------|----------------------|----------------------|----------------------------------------------------------|----------------------|----------------------|----------------------|
|               | Layer 1 <sup>1</sup>                                    | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> | Layer 1 <sup>1</sup>                                     | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> |
| 0             | 0.25                                                    | 0.26                 | 0.25                 | 0.24                 | 0.25                                                     | 0.26                 | 0.25                 | 0.24                 |
| 1             | 0.22                                                    | 0.18                 | 0.20                 | 0.19                 | 0.25                                                     | 0.18                 | 0.20                 | 0.19                 |
| 2             | 0.20                                                    | 0.13                 | 0.17                 | 0.16                 | 0.25                                                     | 0.13                 | 0.17                 | 0.16                 |
| 3             | 0.18                                                    | 0.10                 | 0.13                 | 0.13                 | 0.24                                                     | 0.10                 | 0.13                 | 0.13                 |
| 4             | 0.16                                                    | 0.08                 | 0.11                 | 0.11                 | 0.23                                                     | 0.08                 | 0.11                 | 0.11                 |
| 5             | 0.15                                                    | 0.07                 | 0.09                 | 0.09                 | 0.22                                                     | 0.07                 | 0.09                 | 0.09                 |
| 6             | 0.13                                                    | 0.07                 | 0.08                 | 0.08                 | 0.21                                                     | 0.07                 | 0.08                 | 0.08                 |
| 7             | 0.12                                                    | 0.07                 | 0.07                 | 0.07                 | 0.21                                                     | 0.07                 | 0.07                 | 0.07                 |
| 8             | 0.12                                                    | 0.07                 | 0.07                 | 0.07                 | 0.20                                                     | 0.07                 | 0.07                 | 0.07                 |
| 9             | 0.11                                                    | 0.07                 | 0.07                 | 0.07                 | 0.20                                                     | 0.07                 | 0.07                 | 0.07                 |
| 10            | 0.10                                                    | 0.07                 | 0.07                 | 0.06                 | 0.19                                                     | 0.07                 | 0.07                 | 0.06                 |
| 11            | 0.10                                                    | 0.07                 | 0.07                 | 0.06                 | 0.19                                                     | 0.07                 | 0.07                 | 0.06                 |
| 12            | 0.10                                                    | 0.08                 | 0.07                 | 0.06                 | 0.18                                                     | 0.08                 | 0.07                 | 0.06                 |
| 13            | 0.10                                                    | 0.09                 | 0.07                 | 0.06                 | 0.18                                                     | 0.09                 | 0.07                 | 0.06                 |
| 14            | 0.09                                                    | 0.10                 | 0.08                 | 0.06                 | 0.18                                                     | 0.10                 | 0.08                 | 0.06                 |
| 15            | 0.09                                                    | 0.11                 | 0.08                 | 0.07                 | 0.17                                                     | 0.11                 | 0.08                 | 0.07                 |
| 16            | 0.09                                                    | 0.12                 | 0.09                 | 0.07                 |                                                          |                      |                      |                      |
| 17            | 0.09                                                    | 0.13                 | 0.10                 | 0.07                 |                                                          |                      |                      |                      |
| 18            | 0.09                                                    | 0.14                 | 0.11                 | 0.08                 |                                                          |                      |                      |                      |
| 19            | 0.09                                                    | 0.15                 | 0.12                 | 0.09                 |                                                          |                      |                      |                      |
| 20            | 0.09                                                    | 0.16                 | 0.13                 | 0.09                 |                                                          |                      |                      |                      |
| 21            | 0.10                                                    | 0.18                 | 0.14                 | 0.10                 |                                                          |                      |                      |                      |
| 22            | 0.10                                                    | 0.19                 | 0.16                 | 0.11                 |                                                          |                      |                      |                      |
| 23            | 0.10                                                    | 0.20                 | 0.17                 | 0.12                 |                                                          |                      |                      |                      |
| 24            | 0.10                                                    | 0.22                 | 0.18                 | 0.13                 |                                                          |                      |                      |                      |
| 25            | 0.11                                                    | 0.23                 | 0.20                 | 0.14                 |                                                          |                      |                      |                      |
| 26            | 0.11                                                    | 0.25                 | 0.21                 | 0.15                 |                                                          |                      |                      |                      |
| 27            | 0.11                                                    | 0.27                 | 0.23                 | 0.16                 |                                                          |                      |                      |                      |
| 28            | 0.12                                                    | 0.29                 | 0.25                 | 0.17                 |                                                          |                      |                      |                      |
| 29            | 0.12                                                    | 0.31                 | 0.27                 | 0.19                 |                                                          |                      |                      |                      |
| 30            | 0.13                                                    | 0.33                 | 0.29                 | 0.20                 |                                                          |                      |                      |                      |
| 31            | 0.14                                                    | 0.36                 | 0.31                 | 0.22                 |                                                          |                      |                      |                      |
| 32            | 0.14                                                    | 0.39                 | 0.34                 | 0.24                 |                                                          |                      |                      |                      |
| 33            | 0.15                                                    | 0.42                 | 0.37                 | 0.26                 |                                                          |                      |                      |                      |
| 34            | 0.16                                                    | 0.45                 | 0.40                 | 0.28                 |                                                          |                      |                      |                      |
| 35            | 0.17                                                    | 0.49                 | 0.43                 | 0.30                 |                                                          |                      |                      |                      |
| 36            | 0.18                                                    | 0.53                 | 0.47                 | 0.33                 |                                                          |                      |                      |                      |
| 37            | 0.19                                                    | 0.56                 | 0.51                 | 0.36                 |                                                          |                      |                      |                      |
| 38            | 0.20                                                    | 0.61                 | 0.55                 | 0.39                 |                                                          |                      |                      |                      |
| 39            | 0.21                                                    | 0.65                 | 0.59                 | 0.42                 |                                                          |                      |                      |                      |
| 40            | 0.22                                                    | 0.69                 | 0.64                 | 0.46                 |                                                          |                      |                      |                      |
| 41            | 0.24                                                    | 0.74                 | 0.69                 | 0.50                 |                                                          |                      |                      |                      |
| 42            | 0.25                                                    | 0.78                 | 0.74                 | 0.54                 |                                                          |                      |                      |                      |
| 43            | 0.27                                                    | 0.83                 | 0.80                 | 0.59                 |                                                          |                      |                      |                      |
| 44            | 0.28                                                    | 0.87                 | 0.85                 | 0.63                 |                                                          |                      |                      |                      |
| 45            | 0.30                                                    | 0.92                 | 0.91                 | 0.68                 |                                                          |                      |                      |                      |
| 46            | 0.31                                                    | 0.97                 | 0.97                 | 0.73                 |                                                          |                      |                      |                      |

**Table 4b**  
**Simulated Groundwater TCE Concentrations for Vapor Well VMW-03/04,  
Ambient and Leaching Conditions, DA-4 Site**

| Time<br>(yrs) | Ambient Condition TCE Concentration ( $\mu\text{g}/\text{L}$ ) |                      |                      |                      | Leaching Condition TCE Concentration ( $\mu\text{g}/\text{L}$ ) |                      |                      |                      |
|---------------|----------------------------------------------------------------|----------------------|----------------------|----------------------|-----------------------------------------------------------------|----------------------|----------------------|----------------------|
|               | Layer 1 <sup>1</sup>                                           | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> | Layer 1 <sup>1</sup>                                            | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> |
| 47            | 0.33                                                           | 1.01                 | 1.02                 | 0.79                 |                                                                 |                      |                      |                      |
| 48            | 0.35                                                           | 1.06                 | 1.08                 | 0.84                 |                                                                 |                      |                      |                      |
| 49            | 0.37                                                           | 1.11                 | 1.13                 | 0.89                 |                                                                 |                      |                      |                      |
| 50            | 0.39                                                           | 1.15                 | 1.19                 | 0.95                 |                                                                 |                      |                      |                      |
| 51            | 0.41                                                           | 1.19                 | 1.24                 | 1.00                 |                                                                 |                      |                      |                      |
| 52            | 0.44                                                           | 1.24                 | 1.29                 | 1.05                 |                                                                 |                      |                      |                      |
| 53            | 0.46                                                           | 1.28                 | 1.33                 | 1.11                 |                                                                 |                      |                      |                      |
| 54            | 0.49                                                           | 1.32                 | 1.38                 | 1.16                 |                                                                 |                      |                      |                      |
| 55            | 0.52                                                           | 1.35                 | 1.42                 | 1.20                 |                                                                 |                      |                      |                      |
| 56            | 0.55                                                           | 1.39                 | 1.46                 | 1.25                 |                                                                 |                      |                      |                      |
| 57            | 0.59                                                           | 1.42                 | 1.49                 | 1.29                 |                                                                 |                      |                      |                      |
| 58            | 0.62                                                           | 1.45                 | 1.52                 | 1.33                 |                                                                 |                      |                      |                      |
| 59            | 0.66                                                           | 1.48                 | 1.55                 | 1.37                 |                                                                 |                      |                      |                      |
| 60            | 0.70                                                           | 1.51                 | 1.58                 | 1.40                 |                                                                 |                      |                      |                      |

**Notes**

<sup>1</sup> Layer refers to groundwater model layers

Layer 1 = Shallow Hydrostratigraphic Zone (HSZ)

Layers 2-4 = upper portion of the Upper Subshallow HSZ

$\mu\text{g}/\text{L}$  micrograms per liter  
yrs years

**Table 4c**  
**Simulated Groundwater TCE Concentrations for Vapor Well VMW-12/16,  
Ambient and Leaching Conditions, DA-4 Site**

| Time<br>(yrs) | Ambient Condition TCE Concentration ( $\mu\text{g/L}$ ) |                      |                      |                      | Leaching Condition TCE Concentration ( $\mu\text{g/L}$ ) |                      |                      |                      |
|---------------|---------------------------------------------------------|----------------------|----------------------|----------------------|----------------------------------------------------------|----------------------|----------------------|----------------------|
|               | Layer 1 <sup>1</sup>                                    | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> | Layer 1 <sup>1</sup>                                     | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> |
| 0             | 0.28                                                    | 0.36                 | 0.37                 | 0.37                 | 0.28                                                     | 0.36                 | 0.37                 | 0.37                 |
| 1             | 0.26                                                    | 0.26                 | 0.30                 | 0.30                 | 0.27                                                     | 0.26                 | 0.30                 | 0.30                 |
| 2             | 0.24                                                    | 0.19                 | 0.25                 | 0.25                 | 0.27                                                     | 0.19                 | 0.25                 | 0.25                 |
| 3             | 0.22                                                    | 0.14                 | 0.20                 | 0.21                 | 0.26                                                     | 0.14                 | 0.20                 | 0.21                 |
| 4             | 0.20                                                    | 0.11                 | 0.16                 | 0.17                 | 0.25                                                     | 0.11                 | 0.16                 | 0.17                 |
| 5             | 0.18                                                    | 0.09                 | 0.13                 | 0.15                 | 0.24                                                     | 0.09                 | 0.13                 | 0.15                 |
| 6             | 0.16                                                    | 0.08                 | 0.11                 | 0.12                 | 0.23                                                     | 0.08                 | 0.11                 | 0.12                 |
| 7             | 0.15                                                    | 0.07                 | 0.09                 | 0.11                 | 0.22                                                     | 0.07                 | 0.09                 | 0.11                 |
| 8             | 0.14                                                    | 0.07                 | 0.08                 | 0.09                 | 0.21                                                     | 0.07                 | 0.08                 | 0.09                 |
| 9             | 0.12                                                    | 0.07                 | 0.07                 | 0.08                 | 0.20                                                     | 0.07                 | 0.07                 | 0.08                 |
| 10            | 0.12                                                    | 0.07                 | 0.07                 | 0.08                 | 0.19                                                     | 0.07                 | 0.07                 | 0.08                 |
| 11            | 0.11                                                    | 0.07                 | 0.07                 | 0.07                 | 0.18                                                     | 0.07                 | 0.07                 | 0.07                 |
| 12            | 0.10                                                    | 0.07                 | 0.07                 | 0.07                 | 0.18                                                     | 0.07                 | 0.07                 | 0.07                 |
| 13            | 0.10                                                    | 0.08                 | 0.07                 | 0.07                 | 0.17                                                     | 0.08                 | 0.07                 | 0.07                 |
| 14            | 0.10                                                    | 0.08                 | 0.07                 | 0.07                 | 0.16                                                     | 0.08                 | 0.07                 | 0.07                 |
| 15            | 0.09                                                    | 0.09                 | 0.07                 | 0.07                 | 0.16                                                     | 0.09                 | 0.07                 | 0.07                 |
| 16            | 0.09                                                    | 0.09                 | 0.08                 | 0.07                 |                                                          |                      |                      |                      |
| 17            | 0.09                                                    | 0.10                 | 0.08                 | 0.07                 |                                                          |                      |                      |                      |
| 18            | 0.09                                                    | 0.11                 | 0.09                 | 0.07                 |                                                          |                      |                      |                      |
| 19            | 0.09                                                    | 0.12                 | 0.09                 | 0.07                 |                                                          |                      |                      |                      |
| 20            | 0.08                                                    | 0.13                 | 0.10                 | 0.08                 |                                                          |                      |                      |                      |
| 21            | 0.08                                                    | 0.14                 | 0.11                 | 0.08                 |                                                          |                      |                      |                      |
| 22            | 0.08                                                    | 0.15                 | 0.12                 | 0.09                 |                                                          |                      |                      |                      |
| 23            | 0.09                                                    | 0.16                 | 0.13                 | 0.10                 |                                                          |                      |                      |                      |
| 24            | 0.09                                                    | 0.18                 | 0.14                 | 0.10                 |                                                          |                      |                      |                      |
| 25            | 0.09                                                    | 0.19                 | 0.16                 | 0.11                 |                                                          |                      |                      |                      |
| 26            | 0.09                                                    | 0.20                 | 0.17                 | 0.12                 |                                                          |                      |                      |                      |
| 27            | 0.09                                                    | 0.21                 | 0.18                 | 0.13                 |                                                          |                      |                      |                      |
| 28            | 0.10                                                    | 0.23                 | 0.19                 | 0.14                 |                                                          |                      |                      |                      |
| 29            | 0.10                                                    | 0.24                 | 0.21                 | 0.15                 |                                                          |                      |                      |                      |
| 30            | 0.10                                                    | 0.26                 | 0.23                 | 0.16                 |                                                          |                      |                      |                      |
| 31            | 0.11                                                    | 0.28                 | 0.24                 | 0.17                 |                                                          |                      |                      |                      |
| 32            | 0.11                                                    | 0.30                 | 0.26                 | 0.19                 |                                                          |                      |                      |                      |
| 33            | 0.12                                                    | 0.33                 | 0.28                 | 0.20                 |                                                          |                      |                      |                      |
| 34            | 0.12                                                    | 0.35                 | 0.30                 | 0.22                 |                                                          |                      |                      |                      |
| 35            | 0.13                                                    | 0.38                 | 0.33                 | 0.23                 |                                                          |                      |                      |                      |
| 36            | 0.13                                                    | 0.41                 | 0.35                 | 0.25                 |                                                          |                      |                      |                      |
| 37            | 0.14                                                    | 0.44                 | 0.38                 | 0.27                 |                                                          |                      |                      |                      |
| 38            | 0.15                                                    | 0.47                 | 0.41                 | 0.29                 |                                                          |                      |                      |                      |
| 39            | 0.16                                                    | 0.50                 | 0.44                 | 0.32                 |                                                          |                      |                      |                      |
| 40            | 0.17                                                    | 0.53                 | 0.48                 | 0.34                 |                                                          |                      |                      |                      |
| 41            | 0.18                                                    | 0.57                 | 0.51                 | 0.37                 |                                                          |                      |                      |                      |
| 42            | 0.19                                                    | 0.61                 | 0.55                 | 0.40                 |                                                          |                      |                      |                      |
| 43            | 0.20                                                    | 0.64                 | 0.59                 | 0.44                 |                                                          |                      |                      |                      |
| 44            | 0.21                                                    | 0.68                 | 0.64                 | 0.47                 |                                                          |                      |                      |                      |
| 45            | 0.22                                                    | 0.72                 | 0.68                 | 0.51                 |                                                          |                      |                      |                      |
| 46            | 0.23                                                    | 0.76                 | 0.73                 | 0.55                 |                                                          |                      |                      |                      |

**Table 4c**  
**Simulated Groundwater TCE Concentrations for Vapor Well VMW-12/16,  
Ambient and Leaching Conditions, DA-4 Site**

| Time<br>(yrs) | Ambient Condition TCE Concentration ( $\mu\text{g}/\text{L}$ ) |                      |                      |                      | Leaching Condition TCE Concentration ( $\mu\text{g}/\text{L}$ ) |                      |                      |                      |
|---------------|----------------------------------------------------------------|----------------------|----------------------|----------------------|-----------------------------------------------------------------|----------------------|----------------------|----------------------|
|               | Layer 1 <sup>1</sup>                                           | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> | Layer 1 <sup>1</sup>                                            | Layer 2 <sup>1</sup> | Layer 3 <sup>1</sup> | Layer 4 <sup>1</sup> |
| 47            | 0.25                                                           | 0.79                 | 0.77                 | 0.59                 |                                                                 |                      |                      |                      |
| 48            | 0.26                                                           | 0.83                 | 0.82                 | 0.63                 |                                                                 |                      |                      |                      |
| 49            | 0.27                                                           | 0.87                 | 0.87                 | 0.67                 |                                                                 |                      |                      |                      |
| 50            | 0.29                                                           | 0.91                 | 0.91                 | 0.72                 |                                                                 |                      |                      |                      |
| 51            | 0.31                                                           | 0.94                 | 0.96                 | 0.76                 |                                                                 |                      |                      |                      |
| 52            | 0.32                                                           | 0.98                 | 1.00                 | 0.80                 |                                                                 |                      |                      |                      |
| 53            | 0.34                                                           | 1.02                 | 1.05                 | 0.85                 |                                                                 |                      |                      |                      |
| 54            | 0.36                                                           | 1.05                 | 1.09                 | 0.89                 |                                                                 |                      |                      |                      |
| 55            | 0.38                                                           | 1.08                 | 1.13                 | 0.94                 |                                                                 |                      |                      |                      |
| 56            | 0.40                                                           | 1.11                 | 1.16                 | 0.98                 |                                                                 |                      |                      |                      |
| 57            | 0.42                                                           | 1.14                 | 1.20                 | 1.02                 |                                                                 |                      |                      |                      |
| 58            | 0.44                                                           | 1.17                 | 1.23                 | 1.06                 |                                                                 |                      |                      |                      |
| 59            | 0.47                                                           | 1.20                 | 1.26                 | 1.09                 |                                                                 |                      |                      |                      |
| 60            | 0.50                                                           | 1.22                 | 1.29                 | 1.13                 |                                                                 |                      |                      |                      |

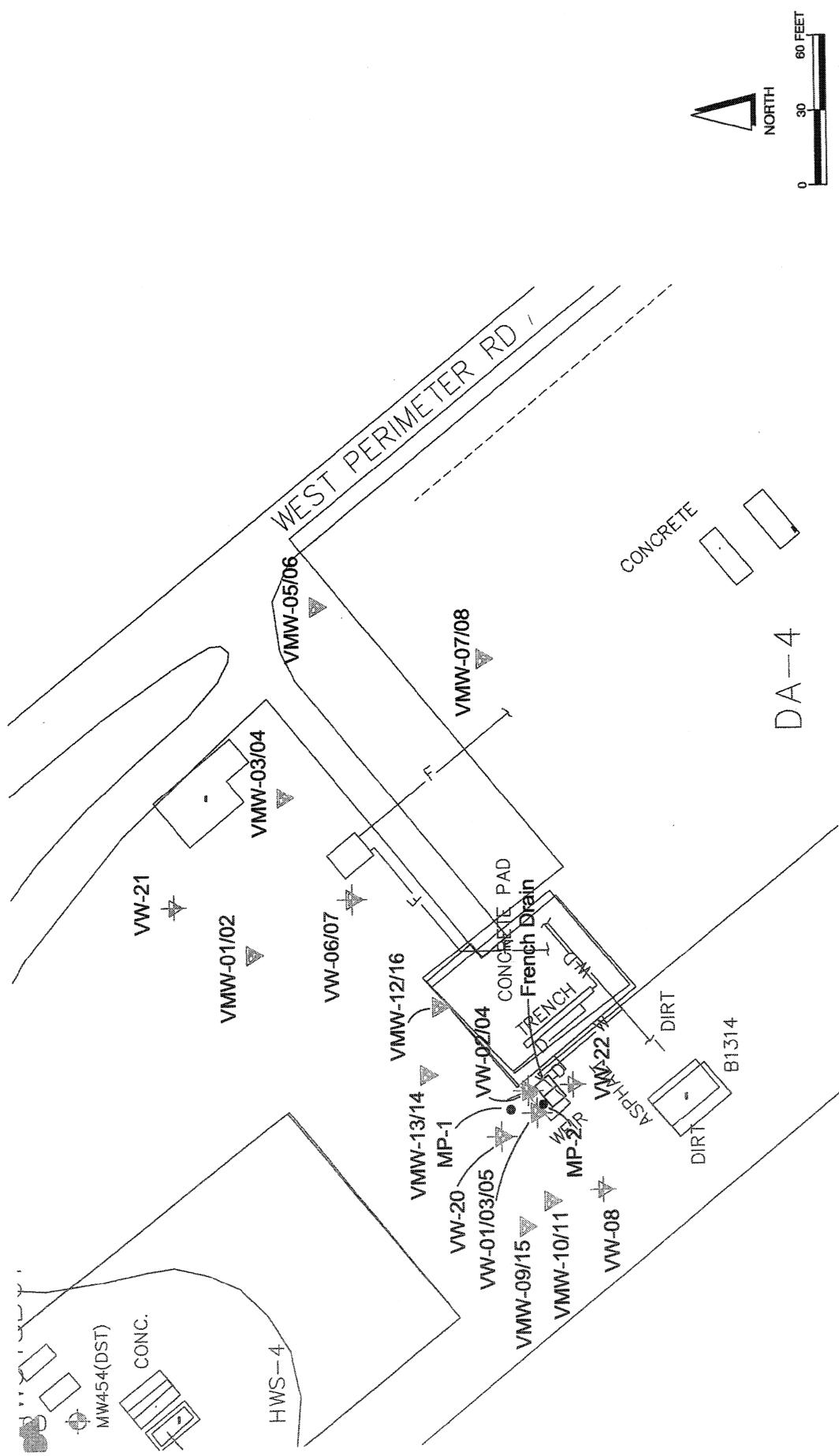
**Notes**

<sup>1</sup> Layer refers to groundwater model layers

Layer 1 = Shallow Hydrostratigraphic Zone (HSZ)

Layers 2-4 = upper portion of the Upper Subshallow HSZ

$\mu\text{g}/\text{L}$  micrograms per liter  
yrs years



#### LEGEND

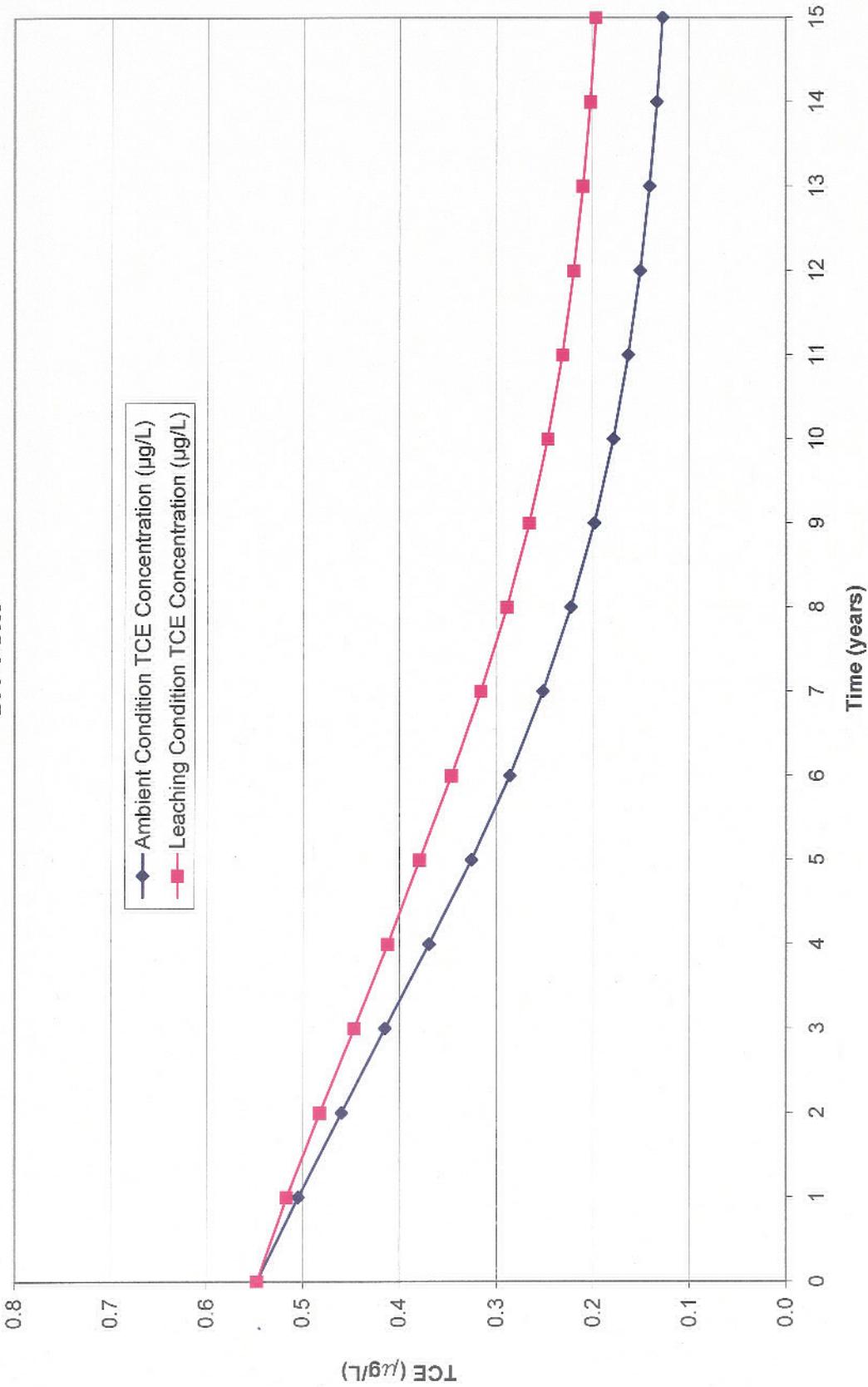
|  |                              |  |                              |
|--|------------------------------|--|------------------------------|
|  | Building                     |  | Background Feature           |
|  | Monitoring Point             |  | Well                         |
|  | Single Vapor Extraction Well |  | Nested Vapor Monitoring Well |
|  | Nested Vapor Extraction Well |  | Vapor Well                   |

#### Vapor Well Locations

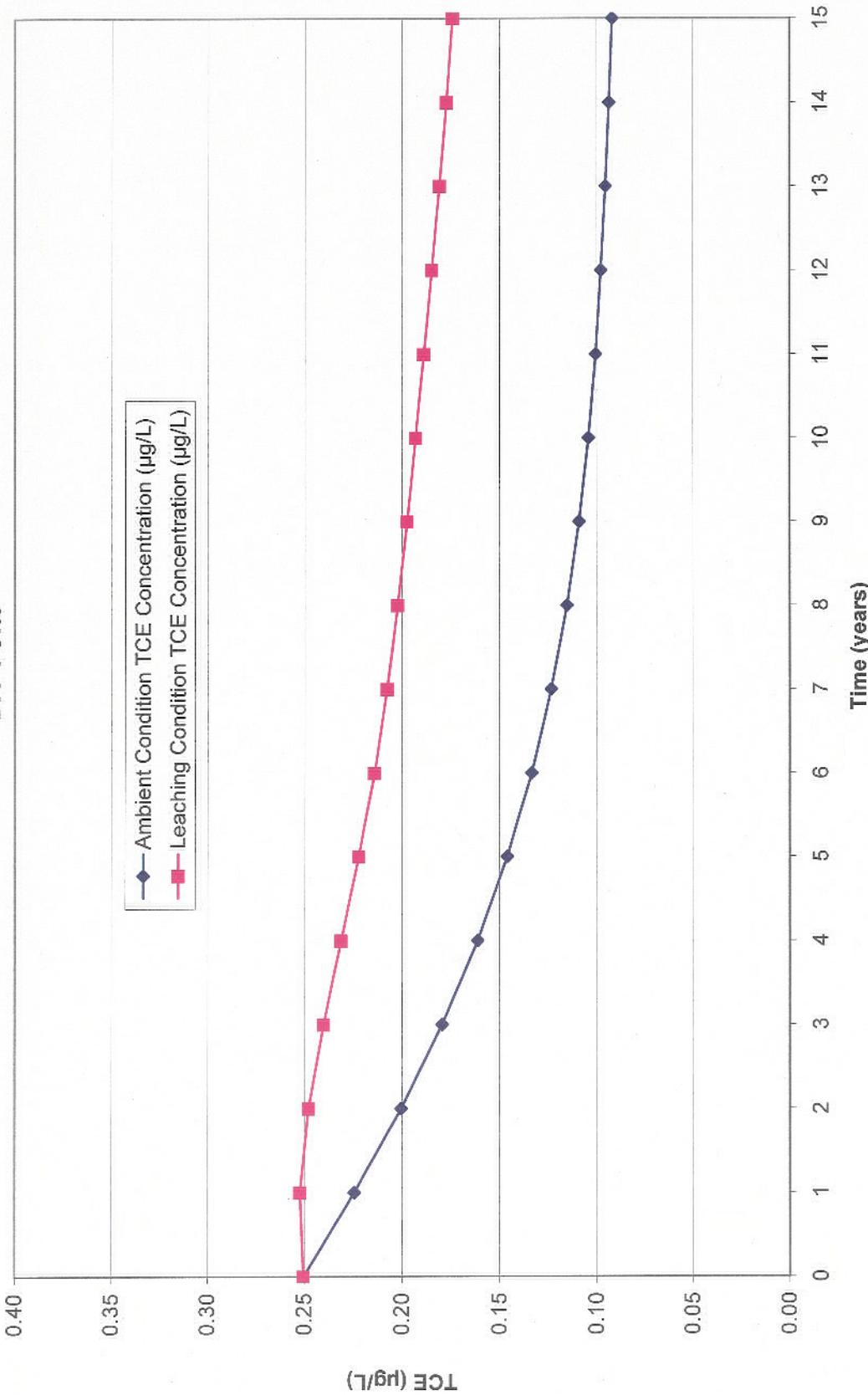
| Date: | Project No. | Castle Airport | Figure |
|-------|-------------|----------------|--------|
| 08-04 | 79887       | EARTH TECH     | 1      |

**Atyco International Ltd. Company**

**Figure 2**  
**Vapor Well VMW-01/02 Model-Predicted TCE Concentrations in Model Layer 1**  
**DA-4 Site**



**Figure 3**  
**Vapor Well VMW-03/04 Model-Predicted TCE Concentrations in Model Layer 1**  
**DA-4 Site**



**Figure 4**  
**Vapor Well VMW-12/16 Model-Predicted TCE Concentrations in Model Layer 1  
DA-4 Site**

